



15

THE ANNALS
AND
MAGAZINE OF NATURAL HISTORY,

INCLUDING
ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LONDON AND
CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY'.)

CONDUCTED BY
WILLIAM CARRUTHERS, Ph.D., F.R.S., F.L.S., F.G.S.,
ARTHUR E. SHIPLEY, M.A., Sc.D., F.R.S., F.Z.S.,
AND
RICHARD T. FRANCIS, F.Z.S.

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VOL. II.—NINTH SERIES.  
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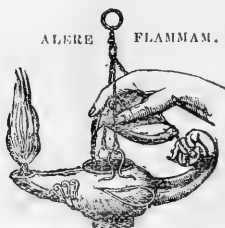
1918.

"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verè eruditis et sapientibus semper exulta; malè doctis et barbaris semper inimica fuit."—LINNÆUS.

"Quel que soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—BRÜCKNER, *Théorie du Système Animal*, Leyden, 1767.

. The sylvan powers
Obey our summons; from their deepest dells
The Dryads come, and throw their garlands wild
And odorous branches at our feet; the Nymphs
That press with nimble step the mountain-thyme
And purple heath-flower come not empty-handed,
But scatter round ten thousand forms minute
Of velvet moss or lichen, torn from rock
Or rifted oak or cavern deep: the Naiads too
Quit their loved native stream, from whose smooth face
They crop the lily, and each sedge and rush
That drinks the rippling tide: the frozen poles,
Where peril waits the bold adventurer's tread,
The burning sands of Borneo and Cayenne,
All, all to us unlock their secret stores
And pay their cheerful tribute.

J. TAYLOR, *Norwich*, 1818.



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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[NINTH SERIES.]

“..... per litora spargite muscum,
 Naiades, et circum vitreos considite fontes;
 Pollice virgineo teneros hic carpite flores:
 Floribus et pictum, divæ, replete canistrum.
 At vos, o Nymphæ Craterides, ite sub undas;
 Ite, recurvato variata corallia trunco
 Vellite muscosis e rupibus, et mihi conchas
 Ferte, Deæ pelagi, et pingui conchylia succo.”

N. Parthenii Giannettusi, Bol. 1

No. 7. JULY 1918.



I.—*Notes from the Gatty Marine Laboratory, St. Andrews.*
 —No. XLI. By Prof. M'INTOSH, M.D., LL.D., D.Sc.,
 F.R.S., &c.

[Plates I.—VI.]

1. On some Points in the Structure of the *Sabellidæ*, chiefly of *Bispira volutacornis*, Montagu.
2. On some Points in the Structure of the *Serpulidæ*, chiefly of *Pomato-cerus triqueter*, L.

1. *On some Points in the Structure of the Sabellidæ,* *chiefly of Bispira volutacornis*, Montagu.

Many authors have alluded to the structure of the Sabellids since Cuvier noted that they rarely form a calcareous tube, whilst they had the fan-like gills and the thoracic membrane of the Serpulids. In alluding to the branchiæ of the Sabellids he mentions “un filament charnu,” and, further, that in this group the two “filets charnus” (fleshy filaments—probably the tentacles) adherent to the branchiæ do not form an operculum. Most text-books, like those of Huxley, Gegenbaur, and Hayek, contain references to the “cartilaginous” skeleton in Sabellids and Serpulids.

Amongst others, R. Wagener* (1832) describes the alimentary canal in *Sabella ventilabrum* (*S. penicillus*, L.) as having two sacs in front, such apparently, from his figure, representing the anterior nephridia. He pointed out the commissures connecting the great nerve-cords.

Milne-Edwards (1838) considered the circulation in the Sabellids to be akin to that of *Nephtys* and the Nereidæ, a dorsal and a ventral trunk being present, and the inner aspect of the integument is supplied with a multitude of vascular filaments for the secretory organs, and, with the bases of the feet, present also a capillary *rete* which probably aids in respiration, though the main respiratory organs are the cephalic fans. He did not allude to the special vascular sinus around the gut.

Grube (1838) gave a general account of the structure of *Sabella unispira* (*Spirographis spallanzani*), especially of the alimentary and circulatory systems. He pointed out that Leuckart was wrong in attributing two vascular trunks to each branchial filament. He thought that the anterior (thoracic) nephridia were connected with reproduction.

Kölliker †, in his researches (1856), describes the "cartilage" of several annelids, such as *Sabella unispira* (*Spirographis spallanzani*), but he was uncertain as to the distinctions between the blood-vessels and the nerves of the filaments, and his figures indicate that his "Knorpelfaden" structurally differs from that described here. He noted the specially thickened hypoderm (his epithelial layer).

De Quatrefages (1850) thought that in the branchiæ of the Sabellidæ and Serpulidæ are venous and arterial twigs, which mingle in a system of vessels the walls of which cannot be distinguished from the surrounding tissues, and in which respiration is carried on through the thin covering tissues and their cilia. He describes in these branchiæ what he terms a cartilaginous skeleton, composed of cells surrounded by a tough fibrous investment like a periosteum. According to this author, the cephalic ganglia in *Sabella flabellata*, Savigny, form two pairs connected by a large commissure, and from these branches go to the branchiæ and the eyes. The œsophageal connectives are very short. The visceral system seems to arise from these ganglia as a small twig on each side furnished with two ganglia. The great ventral nerve-cords are separate throughout, though nearer each other posteriorly, and the first ganglia are close to the cephalic,

* 'Isis,' 1832, p. 655, Taf. x.

† 'Untersuchungen z. vergl. Gewebelehre angestellt in Nizza im Herbste' (1 Sitzung. 13 Dec.).

the others following segmentally, each being joined to its neighbour by fine connectives and giving branches to the muscles and various organs.

Dr. Thos. Williams* (1858) stated that the segmental organs both in Sabellids and Serpulids were absent from the anterior or thoracic region and were present only in the abdominal portion in the form of looped tubes, but he could not distinguish the part of the tube to which the ova were attached. He thought the ova did not escape into the coelom, but were confined in a membranous bag. He found a similar structure in the Amphictenidæ, Spionidæ, and other forms.

In *Spirographis spallanzani* Claparède (1873) describes the giant fibres of the nerve-cords as separate in the inter-ganglionic spaces from the trunk, and figures them (his pl. v. fig. 5) surrounded by connective tissue. Internally is a medullary substance. These fibres run throughout the abdomen without apparent anatomical connection. In the thorax they are repeatedly joined by anastomoses. Throughout the rest of the body the nervous chain is united in each segment by two transverse commissures. On entering the thorax the two tubular fibres divide into two branches, which pass forward reduced in diameter, and ultimately penetrate the cerebral ganglia, where they branch and are lost. Various branches are given off from the tubular fibres along the commissures, but he could not trace them along the ventral nerves of the thorax. The branchial nerves are greatly developed in the Sabellids and in *Myxicola*. He found in *Spirographis* that circular muscular fibres penetrate the ventral shields and that the fibres generally show nuclei surrounded by granular matter. Further, that in transverse section of the setigerous processes the bristles are arranged in a spiral, just as Pruvot and Racovitza showed subsequently. No dorsal vessel exists anteriorly, only a plexus of anastomosing trunks from which the large branchial vessel arises on each side. A periintestinal sinus surrounds the stomach †. There is a well-developed rete in the collar, and the purified blood afterwards enters the ventral trunk.

He considered that in the Sabellids the connective tissue of the anterior region is of importance and aids in filling up the coelomic cavity, which is almost suppressed, except the spaces for the branchial vessels. The two segmental tubes

* Philos. Trans. 1858, p. 123, pl. vii. fig. 13.

† De Quatrefages first described this plexus around the gut (his lacunar system).

in front are curved on themselves, and are highly vascular. He thought they secreted mucus.

He describes and figures the "cartilage" of the branchial apparatus of *Spirographis*, with its "perichondrium," as if this was a separate tissue, and the same tissues occur in *Myxicola* and *Protula*. In his figure this structure is shown as a rod with a single transverse series of septa in the filaments, and his description of the general structure corresponds with that in *Bispira*. His figures of the various parts in the sections of *Spirographis*, though small, are generally true to nature, for the author had equal facility with pen and pencil.

Löwe* (1878-9) distinguishes in the branchiæ of the Serpulids an ectothelium and an endothelium, the former coating the outer surface of the bifid region in a section of the filament, the latter the inner surface. He seems to agree with Kowalewsky in regard to the homologies of the nervous system of worms and vertebrates, and concludes with a comparison of the Sabellid skeleton with that of the embryo dog's skull in horizontal section (his fig. 8).

Cosmovici (1880) considered that, as in *Myxicola*, the organ of Bojanus in the Sabellids was situated at the anterior end, each organ, from a pouch which is longer than in *Myxicola*, opening by a pore, the cilia of the interior causing currents in this direction. The segmental organs are found, he states, in each segment from the middle of the body to the tail, and consist of a ciliated funnel behind the diaphragm and a tube which opens below the setigerous process of the foot. These organs transmit the reproductive elements, which are developed in glands attached to the inferior lateral vessel and extending to the superior lateral vessel. He thus considered the thoracic glands the organs of Bojanus.

A careful account of the thoracic glands and other segmental organs is given by Prof. Haswell† (1884), who, in contrast with the views of some later authors, could find no internal opening of the former. His sections of the thoracic region of *Eupomatus*, a Serpulid, agree on the whole with those of *Pomatocerus*. He points out that the true segmental organs are found in pairs in all the segments of the posterior or abdominal region. He figures the appendix to the thoracic glands in *Eupomatus*, but does not allude to it. The position of the nerve-cords in relation to the ventral longitudinal

* Zeitsch. f. w. Zool. Bd. xxxii. p. 158, Taf. ix.

† Proc. Linn. Soc. N.S.W. vol. ix. pp. 7-12 (sep. copy).

muscles needs revision, but the general structure is in accordance with nature. His account of the circulation in both Sabellids and Serpulids is excellent.

Viallanes * (1885) thought the skeletogenous tissue of the Sabellids (e. g., *Sabella flabellata*) approached that of the vertebrates, though Krukenberg found that chemically it differed. In the tentacles (his antennæ) the skeleton ("tige cartilagineuse") forms a central arc enveloped in thick perichondrium continued from the branchial lamina, and it seems to be absolutely homogeneous and transparent, though composed of a single row of cells. The perichondrium he compares to horn, and it and the "cartilage" have no ground- or fundamental substance. This skeleton is in contact with a blood-vessel which passes to the tip and is surrounded by a lymphatic space, and he thought that the lymph, and not the blood, respired directly.

Pruvot † (1885), like many others, alluded to the branchial "cartilage" of the Sabellids, and described the union of the dorsal and ventral longitudinal muscles to form two large cylindrical muscles which go to the branchiæ, a fasciculus passing to each filament. The anterior thoracic glands are coiled or tangled ("enchevêtrés"), and open dorsally behind the branchiæ in the median line. He did not place the same weight as Claparède did on the distinctions of this organ in the Sabellids and Serpulids respectively, and they are soldered in the middle line in *Sabella penicillus*. The tentacles (his antennæ) vary from the normal two to ten or twelve (*Sabella terebelloides*, *S. analis*, &c.). In *Apomatus ampulliferus*, Phil., there are three pairs, and they resemble the branchial barbules, whilst in *Potamilla reniformis* two pairs occur, the first being well differentiated, but the second represents an intermediate structure with the branchial barbules.

Andrews ‡ (1891) described the structure of the compound eyes of annelids, his *Potamilla reniformis* having seven or eight eyes on each branchial filament instead of the three given by Malmgren; and *Sabella microphthalma*, Verrill, has them on the outer side of each branchial stem, which likewise has transverse bars of pigment. In *Dasychone conspersa*, Ehlers, the eyes also occur along the outer bases of

* Ann. Sc. Nat. 6 sér. t. xx. pp. 1-20, 1 pl.

† Archiv. Zool. Expér. 2 sér. t. iii. p. 335.

‡ Journ. Morphol. pp. 271-399, pl. xxi.

the filaments (pl. xxi. figs. 20-22); and, lastly, he gives an account of *Sabella melanostigma* (pl. xxi. figs. 17-19).

A large memoir on the structure of the Tubicolar Polychæts (chiefly Sabellids and Serpulids) was published by Soulier * (1891). It deals particularly with such forms as *Spirographis spallanzani*, Viviani, *Branchiomma vesiculosum*, Montagu, *Sabella viola*, Grube, *Myxicola infundibulum*, Montagu, and *M. æsthetica*, Claparède; whilst amongst Serpulids *Protula milhaci*, Marion, *Serpula infundibulum*, D. Chiaje, and *Hydroides pectinata*, Müller, were specially studied. Interesting accounts are given of some of these in captivity, including the formation and structure of their tubes and other features. His interpretation of the structure of the anterior "nephridia" (pericæsoophageal glands) for the most part agrees with that of Ed. Meyer. The histology of the skin and other organs is described with great detail in this paper.

A memoir by Ed. Meyer † on the Sabellidæ and Serpulidæ (his Serpuliden) was published in Russian in 1893. A careful account of the nephridia in *Eupomatus* and *Psygmobanchus* and the structure of the body-wall is given, along with the structure of the nephridia in *Sabellaria alveolata*. Late stages in the development of *Psygmobanchus protensus* further elucidate the subject. Like Soulier, he describes and figures a ciliated funnel opening into the perivisceral cavity at the cephalic end of the anterior segmental organs or thoracic glands. Since the work of Claparède no investigator except Eisig has more fully dealt with the structure of the Polychæts, more especially of the Sabellids and Serpulids, and his memoirs in the Naples 'Mittheilungen' ‡ are models of patient research, skilful draughtsmanship, and general accuracy.

Otocysts were early described in the Sabellids by De Quatrefages (1844) in an *Amphicora*, and, amongst others, Claparède, Langerhans, Meyer, Brunotte, De St. Joseph, Caullery and Mesnil, Soulier, and Fauvel have studied their occurrence in this group. The most comprehensive account is given by Fauvel § (1909), who describes them in *Branchiomma vesiculosum*, in the first bristled segment, in two species of *Potamilla*, viz. *Potamilla reni-*

* Thèse, 'Etud. sur l'Anat. des Annél. Tubic. de la Cette, Secret. du Tube, &c.,' Montpellier, 1891.

† 'Die Organisation de Serpuliden u. Hermelliden,' Kasan, 1893, 3 pls.

‡ *E. g.*, Bd. vii. and Bd. viii.

§ Ann. Sc. Nat. 9 sér. t. vi. pp. 1-144, pls. i.-iii.

formis and *P. forelli*, in *Amphiglena mediterranea*, three species of *Jasmineira*, viz. *J. caudata*, *J. oculata*, and *J. elegans*, in *Myxicola infundibulum* and three other species of *Myxicola*, in three species of *Chone*, viz. *C. dumeri*, *C. arenicola*, and *C. collaris*, in *Euchone rosea*, *Dialychone acustica*, in *Oria armandi*, and *Orcopsis metchnikowii*. In this family they occupy the first bristled segment and they are innervated from the œsophageal collar. As in other annelids, Fauvel considers that these organs perform the function of statocysts, for perceiving vibrations, and are, perhaps, also organs of orientation.

Numerous instances of the regeneration of both extremities have been recorded in the Sabellids. Thus, Dalyell* observed the reproduction of both ends in *Sabella pavonia* (his *Amphitrite ventilabrum*). Grube and De St. Joseph subsequently found a similar condition in the same species. C. Vaney and A. Conte† described regeneration after experiments in *Spirographis spallanzani*. Ivanow‡ and Orlandi§ respectively studied the same species in regeneration. Grube|| found renewal of the anterior region in *Potamilla reniformis* and De St. Joseph¶ in *P. forelli*, with regeneration of the branchiæ in *Myxicola dinardensis* and in *Dasychone bombyx*. Soulier**, again, describes regeneration of the branchiæ in *Branchiomma vesiculosum*.

One of the most complete accounts of the regeneration of the anterior and posterior ends of a sedentary annelid is that of P. Ivanow‡ (1908) in *Spirographis spallanzani*. Both text and figures are full of interest—especially as regards the nervous system and segmental organs. Many authors, however, describe bifid posterior ends of other species.

The Sabellidæ, like the Terebellidæ, are stated by Dr. Goodrich†† to possess nephridia which open internally, and that the genital funnel becomes connected with the nephrostome and loses its primitive opening to the exterior.

An account of the "cartilaginous" substance in the branchiæ of *Spirographis spallanzani*, *Branchiomma köllikeri*, *Sabella reniformis*, and *Sabella infundibulum* is given by

* 'Powers of the Creator,' vol. ii. p. 225 (1853).

† Bull. Mus. Hist. Nat. t. xiv. (1908).

‡ Zeitsch. f. w. Zool. Bd. xci. p. 511, Taf. xx.-xxii.

§ Archiv. Zool. Napoli, vol. iii. 2 fig. (1906).

|| 'Ein Ausflug-Triest u. Quarnero,' 1861.

¶ "Annél. Dinard," Ann. Sc. Nat. 7 sér.

** Trans. Instit. Zool. Montpellier, 1891.

†† Quart. Journ. Micros. Sc. vol. xliii. n. s. p. 740.

Nowikoff* (1912), illustrated by representations of stained sections, which indicate the position of muscles, nerves, and blood-vessels as well as the skeletogenous elements. He regards the supporting substance as homologous with that in Mollusca and Vertebrates, presenting, moreover, less polygonal or somewhat rounded cells, with ground-substance of a chondro-mucoid character, with nuclei and protoplasmic contents, and having externally a layer, which he terms perichondrium, upon which the cuticle and its nuclei rest. The author does not go into the distribution of the skeleton in the foregoing forms, but confines his attention chiefly to the histology of the tissue, the so-called "cartilage"-cells being filled with fluid, and almost resemble plant-cells from their distinctness. They possess one, rarely two, nuclei. The perichondrium is granular and has an alveolar (basement-) layer between it and the hypoderm.

The structure of the body-wall in *Sabella penicillus*, L., is typical, though there are special developments of the surface. Thus, on each side of the mid-ventral line a thick glandular layer outside the circular muscular coat occurs. This appears to be a special development beneath the hypoderm, which is readily traced over it and along each side of the mid-ventral fissure. The circular muscular coat is well developed and is continuous or nearly so. The dorsal longitudinal muscles are in section thick externally, but taper to the mid-dorsal line, where a hiatus for the suspensory mesentery of the alimentary canal occurs. These muscles are comparatively narrow and do not reach the lateral edge. In the same way the ventral longitudinal muscles are compact or almond-shaped in section, slightly thinned internally, and each is separated by a wide gap from the muscle of the opposite side. Both dorsal and ventral longitudinal muscles have a translucent sarcolemma on the free surface and both show bands of sarcolemma here and there cutting the mass into various fasciculi. Under the inner edge of each lies the nerve-trunk surrounded by neurilemma and with comparatively little neuroglia. On the upper and inner edge of each is a large neural canal, which in many sections is larger than the nerve-trunk and is occupied by a coagulable material. It appears to be unnecessary to call such a tube a giant nerve-fibre, and, indeed, the term neural canal was adopted in 1877†; and may as well comprehend the finer

* Zeitsch. f. w. Zool. Bd. ciii. p. 686, Taf. xvi.

† "On the Arrangement and Relations of the Great Nerve-cords in the Marine Annelids," Proceed. Roy. Soc. Edin. Session 1876-77.

canals, which can be traced into nerve-cells. An intricate series of fibres in transverse section occurs in the middle line between the nerve-cords and surrounds a small granular area above and another below. In each segment (probably at the junction) a very complex series of fibres—chiefly transverse and oblique—commingle over the nerve-area, whilst in the intermediate regions the ventral vessel and the muscular fibres and mesentery attached to the lower edge of the alimentary canal are more distinct. The alimentary canal itself is normal in section, and it has large blood-sinuses and vessels on its wall, besides the dorsal trunk (in its region). The thoracic glands occur in front, and the segmental organ lies to the exterior of the ventral longitudinal muscle.

Toward the posterior end, whilst little change takes place in the hypoderm and the ventral subhypodermic belt, or in the circular muscular coat, the dorsal longitudinal muscles are considerably extended laterally, whereas the ventral longitudinal muscles are diminished in transverse diameter and have the bristles close to their outer edge. The nerve-cords occupy the same position at the inner edge of the muscles and next the circular coat, the neural canal having about the same proportional size as in front. The complex crossing of fibres above the area occurs at intervals as in front. The gut in this region is filled with dark sandy mud.

Branchial Apparatus.—One of the most interesting features in the structure of the Sabellids, such as *Bispira volutacornis*, Montagu, is the chordoid skeleton which supports the branchial apparatus, and which commences behind the brain as a small lateral area (Pl. III. fig. 15, *ch.*), which soon develops into an arc on each side (Pl. I. fig. 1, *ch.*). About the region of the brain the lateral arcs fuse in the mid-dorsal line (Pl. I. fig. 2, *ch.*) and thus form a continuous curved belt from side to side, not, however, of uniform breadth in a given section, but with indentations, as at the large cœlomic area dorsad of the brain or at the enlargements laterally. This chordoid tissue is finely reticulated in the adult, more distinctly cellular in the young, the connecting walls staining slightly, and nuclei are very evident, especially in young examples. It is bounded externally by the firm investment or “perichondrium,” the basement-tissue and muscular layers, hypodermic and articular, whilst internally it is bounded by the same homogeneous border of “perichondrium” to which muscles are attached. This “perichondrial” boundary (Pl. II. fig. 10, *pr.*) is not a separate layer, but processes from its inner edge all round pass as bridles to the reticulations and cells composing the interior, so that the two are modifications of the same tissue, the whole organically connected

as a stout supporting layer externally and a central region of complex reticulations. There is thus a considerable divergence from the bone-forming periosteum or the perichondrium of vertebrate cartilage, though the structureless matrix of the latter with its enclosed cells comes nearest. The great mass of this chordoid skeleton is dorsal, as are also the ganglia, whilst the great nerve-cords rapidly seek a ventral position, the former being above the alimentary canal, the latter beneath it. The muscular fibres on the inner curve of the chordoid skeleton about the level of the open vestibule—that is, before the closure to form the œsophagus—are not longitudinal, but oblique or vertical, stretching from the lower part of the inner concavity to the upper part of the arch, so that they would shorten the curve. Moreover, the “perichondrial” border shows large reticulations on its inner edge, a feature of importance in the elasticity of the parts during the varied movements (Pl. II. fig. 10). The inner border of this tissue widens at the level of the full development of the apparatus, and at its broad lateral part the sides of the curve projecting outward are laced together by muscular fibres, so that the curve—acute as it is—can be shortened. At this level also the chordoid central area is strengthened by special processes of the marginal tissue (“perichondrial” of authors). At the origin, again, of the chordoid skeleton (Pl. III. fig. 15, *ch.*) transverse muscles connect the two sides, and mesenterial fibres pass from their lower edge to the œsophagus, whilst the common duct of the thoracic glands is clasped by the strands. It forms a protective shield and support to the two great vascular trunks, the cœlomic spaces, and to the cephalic ganglia, whilst stiffening the attachments of the muscles of the region; indeed, in extent, it exceeds the cephalic skeleton of the cuttlefishes, and yet it has a certain degree of elasticity in the varied and graceful movements associated with the display of the branchiæ. Passing forward the lateral regions of this chordoid skeleton enlarge and begin to present intruding pillars, cutting the outer edge into regular spaces with convex margins externally, the first indication of the bases of the branchial filaments. Then the chordoid tissue arranges itself in long lobes connected with a narrow and rapidly diminishing inner belt of the same tissue, and this is soon followed by the disappearance of the inner belt and the inner portion of each lobe, leaving only a rounded or ovoid chordoid area marking the origin of each filament (Pl. II. fig. 12). The space occupied by the chordoid arch is now the seat of a series of radially arranged muscular bands, two for each filament, a connective-tissue septum from each chordoid oval passing in transverse section

between them. The cuticle and hypoderm externally become crenate and then notched, whilst spaces or slits appear between the chordoid ovals, by-and-by pass to the surface, and thus truncated fillets representing the separate filaments are formed all round the edge of the branchial base. The outer edge of each has a thick coat of hypoderm under the cuticle, but this diminishes internally on the sides, becoming thinner in its progress inward, the whole area resembling a narrow wedge with the broad end outside (Pl. II. fig. 12). Within the broad end is the basement-membrane and a "perichondrial" area surrounding the chordoid oval from which the median strand passes inward to support the blood-vessel. In this region the bases of the filaments and their axes are joined by a long band of the "perichondrial" substance, the appearance after partial maceration resembling a chain of *Perophora listeri* or similar series of tunicate stolons.

The two bands of muscle then show signs of diminution. Just before the filaments separate, small clear spaces occur at somewhat regular intervals in the interfilamentar tissue, but they are not visible after separation. At this level the sections of the bases of the filaments have their longest diameter radial (Pl. II. fig. 12), but this by-and-by shortens, and their inner border separates from the internal lining at the base, and each forms an independent filament, the muscular fibres, meanwhile, gradually diminishing. The chordoid cells in these form a double row (Pl. II. fig. 12), sometimes with two nuclei, but generally with a single nucleus in each, and the number of cells diminishes in the distal parts of the filament (Pl. I. fig. 4). When a pinna is cut longitudinally, a double row of cells is present in the sections (Pl. I. figs. 5 & 6), besides the external investment, or, as the knife slants superficially, the closer lines indicating the cells of the hypoderm intrude, as at the lower part of the drawing (fig. 6). The nerve occupies an area near the ciliated groove at the inner border. The double character of the slits is still preserved, for one-half of the inner joins that of its neighbour to the right, and the other that to the left. Then the diameter of each filament, now free, still further diminishes, and the blood-vessel is separated from the chordoid skeleton only by a narrow belt of connective tissue. Moreover, a double row of pinnæ springs from the inner and narrower edge, the outer having its thicker belt of hypoderm and its more massive connective-tissue layer and nerve internally. A single row of chordoid cells passes from the chordoid oval into each pinna as its skeletogenous rod, and thus the whole system is continuous from its massive

base to the threads in the delicate pinnæ, which have a thick coat of hypoderm and a ciliated cuticle. In the young *Bispira* the chordoid cells are especially large and distinct.

The branchial skeleton thus springing from a firm base spreads forward (or, as usually described, "upward") as a vase- or funnel-shaped sheet, binding together the bases of the filaments and, finally, dividing into the isolated rods for the filaments and pinnules. At the origin of the filaments the skeletogenous tissue forms a broad belt, continuous externally as a narrow rim, and having within this a small group of the chordoid reticulations, then a series of skeletogenous areas (in section) sometimes with marginal muscles, indicating the rudiments of the filaments. The chordoid reticulations then become more numerous, the "perichondrial" area diminishes, the soft parts increase, and by-and-by the separate filament is evolved. The chordoid rods to the pinnules appear to pierce—if such an expression can be used in connection with this continuous tissue—the "perichondrial" investment of each filament, and come into contact with the reticulations at the outer part of each. The whole chordoid skeleton is, however, a continuous structure, and it is only the continuity of the areolæ of the pinnules with those of the filaments which makes the use of the term "piercing the perichondrium" intelligible. A comparison of the adult and young specimens of the annelid show that the nuclei are remarkably distinct in the latter, whilst the smaller number and proportional larger size of the cells are features of moment. Many previous authors having used, in connection with this skeletogenous tissue, terms which would imply separate tissues, it has been necessary to insist on the unity of the structure as a whole.

Another feature of the chordoid skeleton is its connection with the shedding of the whole branchial apparatus in the Sabellids, for all the chordoid tissue appears to be thrown off with the branchial fans and the tentacles, the funnel-shaped anterior or distal portion consisting largely of this tissue covered by the integuments. The vessels on the proximal side would thus be more readily constricted, and an active surface for the reproduction of the apparatus uncovered. Whether this shedding of the branchial fans occurs frequently in nature is an open question, but the annelids in confinement sometimes do so.

The branchial fans double inward at their ventral base as a thin lamina with miniature filaments, each with its chordoid axis, and along the inner border of each the nerve-strands occur.

The tentacles (Pl. I. fig. 3, *t.*) belong to the branchial system, and separate in such a form as this and probably in all or many Sabellids, along with the branchiæ, which in their normal line of separation show a notch between the symmetrically curved chordoid basal support, which unites the halves above the gap by a firm bar of similar tissue. A little beyond the outer edge of this bar on each side springs a tentacle, the spout-shaped external basal fold of which is deeply pigmented with brown in *Bispira*. The inner basal web of each runs forward on the first dorsal branchia, whilst the outer web forms a free flap, the important furrow from the base of the branchial fan lying between them, and it is this groove which is pigmented. The tentacle itself is continuous with the inner flap or base, and presents a somewhat thicker median rib supported by the chordoid skeleton, the whole tapering to a delicate tip. Its nerve is of considerable size, and the organ is probably of great importance in regard to the nature and contents of the currents swept through the groove. Claparède* applied the term "tentacle" to the inner lateral fold of the mouth in his sections, but such is a wholly different structure from the tentacle as here described, and performs a different function.

In transverse section the tentacle, when fairly formed, presents a rounded axial region and two flaps or lamellæ arranged in opposite curves (Pl. I. fig. 7). The curves of the lateral flaps or wings are diagnostic, and indicate special functions, one flap curving to the left of the central region and the other more or less to the right in transverse section. Over the whole is the cuticle, then a layer of short nucleated epithelium resting on a basement-tissue, and within it a consistent connective tissue and probably muscular fibres, though these are indistinct on the wings. The central region is more or less rounded in section, with a tough cuticle and thinner hypoderm, but it is supported by a transparent skeletogenous axis containing a homogeneous substance surrounded by granules, whilst on one side (that furthest from the curved flaps) is a band of muscular fibres and on the other a nerve. The fact that this homogeneous substance does not stain would point to its solidity or coagulability. It is noteworthy that in the marginal line of filaments connected by the "perichondrial" strand, similar appearances, without the granules, in section are found, so that the tinted centre may be of the same "perichondrial"

* Annél. Sédent. pl. i. fig. 1, *tt.*

substance. The curve of the larger flap, which appears to be normal, would seem to show that the connective tissue in its middle is more or less elastic. Viewed in section the central rib presents cuticular and hypodermic coverings, then the transparent skeletogenous layer, which shows no evidence of cameration, and in the centre the tinted coagulable substance surrounded by the granules. In all probability this is a blood-vessel, and a trunk is seen in other forms, such as *Spirographis*, running up the centre of the skeletogenous sheath which ends in a delicate tip; and in the basal region of the tentacle numerous fine twigs ramify in the tissues. In sections from the tip downward the longer curved flap lies within the outer branchial row, between it and the tip of the inner row, and it has a blood-vessel at its edge.

Nervous System.—The cephalic ganglia in section (Pl. I. fig. 1, *cg.*) form two ovoid masses, connected by a broad commissure, and situated about the commencement of the chordoid skeleton of the region. The outer and more cellular part of each ganglion stains slightly, whilst the inner region and the commissure are pale. Moreover, at the outer edge of each mass is a pale area in section surrounded by brown pigment apparently representing an eye (Pl. III. fig. 14, *oc.*), and thus akin to the deep-seated eye of the ammocete stage of the lamprey, though it does not reach the surface in adult life. The capsule is consistent and stains, the centre being pale as if functioning as a lens, whilst the brown pigment seems to be chiefly massed on the inner border. Between the dorsal mass of muscle and the ganglia is a large vascular trunk on each side—the branchial—besides a closely reticulated tissue, the same tissue occurring laterally where the lower ends of the muscles cease; whilst the œsophagus in the middle line below the commissure, and its sheath of muscle and connective tissue abuts inferiorly on a broad glandular hypodermic area ventrally, the apex of which is joined to the œsophageal sheath by the same reticulated connective tissue mentioned previously. In front of the ganglia a large cœlomic space and a vascular trunk lie at the base of the branchial apparatus before separation into branches for the filaments.

The sections, at the separation of the great nerve-cords from the cephalic ganglia were somewhat imperfect, but these trunks appeared to follow a similar course to those of *Spirographis*, as described and figured by Meyer* and others.

* Mitt. Zool. Stat. Neapel, Bd. vii. Taf. xxiii. fig., and Bd. viii. pp. 537–569.

The great cords after the disappearance of the eyes pass downward with their cellular sheath to the sides of the œsophagus (Pl. III. fig. 15), having beneath them only the dense mass of the ventral glandular hypoderm, the œsophagus being surrounded by the tissues of the region before this takes place, and, as those around the organ are chiefly muscular, firm constriction of this part can readily occur, the distinction between this region, imbedded as the gullet is in firm contractile tissues (Pl. II. figs. 8 & 9), and that which follows—in which the canal is more or less free—is therefore marked. Proceeding backward the œsophagus is fixed by a median mesentery ventrally and by various strands dorsally to a transverse sheet above it and the nerve-cords, a space, divided into two by a median muscle, occurring above—that is, below the dorsal longitudinal muscles (Pl. II. fig. 8). The nerve-cords with their investment then pass below the level of the alimentary canal and lie at some distance from each other at the inner border of the ventral longitudinal muscles, the ventral blood-vessel being between them and the massive ventral hypoderm externally. A small neural canal is now visible at their upper and inner border, no trace of this having been observed previously, as the great cords lay at the sides of the gullet. Passing gradually downward the cords are enclosed by fibres from the circular coat crossing above and below them (Pl. II. fig. 8), the small neural canal, sometimes two, being visible—for instance, at the ganglia in the nerve-sheath at the upper and inner angle of each. The nerve-cells are confined for the most part to the exterior investment of the ganglia and the trunks, though some are in the substance of both. The transverse (circular) fibres above the cords increase in strength, and are further stiffened by the fusion of strong muscular fibres from the sheath of the alimentary canal in the middle line. Other fibres pass outside the cords, and even between them in the intervals between the ganglia, so that in this region they are well supported and they are nearer each other than in front. The transverse (circular) fibres above the cords remain after the muscular band from the gut disappears and a median mesentery takes its place, whilst the small neural canal shows little change. Proceeding backward, the ventral blood-vessel is surrounded by a thick ring of muscular and connective-tissue fibres fixed ventrally between the neural canals and beyond them. The neural canals are now considerably larger, and the gut and the ventral vessel are connected with the slender transverse fibres by a thin mesentery; but this only lasts for a short distance, when the thick investment of the trunk again appears in the progress

backward, so that an intermittent arrangement is present, a feature probably due to the intervals between the thicker mesenterial bands from the gut, these bands being composed of fibres studded with nuclei; and the fibres cross each other on their way to those beneath the cords in the interganglionic areas. The neural canal is sometimes double on one side, single on the other. At the thickened perivascular areas the gut touches or is sessile on the coat of the vessel. In the intermediate regions, where the vessel hangs in a thin mesentery, it has a pigmented coat of clavate chloragogen-cells (Pl. III. fig. 17, *chl.*), the broad end being external, so that they form an arc on each side. The secretion of these, no doubt, is of some importance in connection with the vascular trunk and the coelom*. Anteriorly, when the thickened coat occurs, the pigmented cells are placed to the exterior of the arch on the coelomic surface, but, by-and-by, in the progress backward they are grouped inside the channel of the tube on the blood-vessel, and this continues till it again is free. The great cords are now more rounded in section, with the neural canals at their upper border or at their outer and upper border, and on the right side in one case two are present, the larger almost extra-neural and pressing into the border of the ventral muscle. Comparatively few cells occur in the interganglionic areas, the general surface of the cords in section being finely granular and somewhat reticulated so as to form rounded areas. The cells increase at the ganglionic regions, and appear chiefly in the neuroglia, only a few occurring in the commissural band. Posteriorly, the cords in section at a commissure are placed close together with the neural canals between them, the nuclei of the neuroglia scattered thinly in their area in section and more thickly exteriorly.

A short distance behind the foregoing the body-wall assumes its normal arrangement, the ventral longitudinal muscles lying within the hypoderm, basement-tissue, and circular coat, whilst the nerve-cords and the intermediate ventral blood-vessel occupy the space between their inner ends. Each cord has the circular muscular coat, the basement-tissue, and the glandular mass of the shield externally, with its fibrous area inferiorly, and above it is the now large neural canal, which has a firm wall and usually a coagulum

* In a large example a peculiar and symmetrical appearance was caused anteriorly by the intrusion of the massive ventral coat of hypoderm on each side of the cords and their ganglia, so as to form an arborescent mass above and on each side over the inner ends of the ventral longitudinal muscles. Such probably was due to pressure in preparation.

in its lumen, the edge of which stains deeply. A reticulated investment (neurilemma) separates it from the ventral blood-vessel, and a firm layer of the same tissue roofs in the entire area, the fibres of which closely link it on to the alimentary canal immediately above. The neural canal soon becomes as large as the section of the nerve, and, as mentioned, it seems unnecessary to term it a "giant fibre."

Cunningham* (1888) is inclined to regard the neural canals as supporting structures, which prevent the nerve-cords being bent at a sharp angle, and where they are highly developed the cords are not separated from the epidermis. He states they have a position similar to that of the notochord in relation to the neurochord and aorta. He failed to trace a connection between these canals and any ganglion-cell, whilst admitting their homology with those of the Errant annelids.

In a section of a young *Bispira* stained with Ehrlich's hæmatoxylin, the cephalic ganglia are rather widely separated, for they occupy the upper and outer border of the vestibule leading to the mouth, and which has the outline dorsally of the letter M. To the exterior is a pale belt free from cells, then a band of muscular fibres inside the chordoid layer with its investment, whilst the cuticle and hypoderm form the superficial coverings. The chordoid cells are large, distinct, and transparent, each with its nucleus, and sometimes with two, and they form at the level of the brain a horseshoe guard on the dorso-lateral region, the ventral aspect of the ganglia abutting to a large extent on the mucous membrane of the vestibule, the isthmus between them following the descending bars of the M in its progress from side to side. Moreover, in contact with the isthmus dorsally are the basement-membrane and the hypoderm of the cephalic *cul-de-sac* in free communication with the sea water. The organ thus is in a favourable position for receiving impressions from the exterior as well as by its nerve-trunks, whilst the elastic chordoid skeleton gives sufficient protection. In the transverse sections the entire ganglion on each side is dotted with deeply stained nerve-cells, which perhaps are most numerous toward the surface, and they extend into the nerve-trunks, leaving the organ, as well as being distributed on the isthmus from side to side. In some cases they are grouped in arcs with the pale neuroglia between, as if pertaining to a lobule, but, as a rule, there is little definition in this respect. Immediately behind, the

* Quart. Journ. Micros. Sc. n. s. vol. xxviii. p. 275.

nerve-mass bulges ventrally at the sides of the vestibule, and the trend of the intervening commissure is more or less straight—from the change in the roof of the vestibule, the central lines of the M being more or less obliterated.

The eyes (Pl. III. fig. 14) do not appear in the sections until the protective chordoid tissue has diminished to a small arc above the posterior region of the cephalic ganglia, and when a mere chink above the gullet indicates the external pit in communication with the sea-water. The œsophagus itself is now enclosed in connective tissue and circular muscular fibres. The eyes rest on the ganglia, and the great trunks arise near, and show a pale faintly granular central area and a thick investment of neuroglial cells. The eyes have dense brown pigment-cells apparently radially arranged round a pale region, which probably represents a lens, a thinner layer of the pigment occurring on one side of the elliptical organ according to the level of the section. In some sections a pale spot appears in the centre of the pale brownish median region, the dark pigment forming a belt exteriorly. These eyes appear to be similar to those Meyer* found in *Psymbranchus protensus* (= *Protula tubularia*, Mont.) and *Amphiglena mediterranea*.

In *Serpula contortuplicata* (= *Hydroides norvegica*) De Quatrefages describes the cephalic ganglia as large and only separated by a constriction in the middle line, and giving off from each side a large branch to the branchiæ. The œsophageal connectives are longer than in *Sabella*, and from the first widely separated pair of ganglia a considerable trunk passes to the "voile palléal" (the thoracic membrane). The ventral cords remain separate, and ganglia connected by a slender commissure occur in every segment. The trunks are wider apart anteriorly than posteriorly.

Muscular System and Body-wall.—About the level of the brain muscular fibres are fixed to the inner wall of the chordoid skeleton (Pl. II. fig. 10, *m.*), which here attains great development, and their general trend shows that they draw the horseshoe bend of the skeleton close. Proceeding backward, a strong longitudinal muscle (Pl. I. fig. 1, *m.*) appears at the ventral end of the diminished chordoid area, and a smaller muscle above the skeleton, and the disappearance of the skeleton permits this muscle to form a continuous curved sheet, widest below, in the area formerly occupied by the skeleton, and it soon approaches its fellow of the opposite side, separated only by a series of transverse

* Mitt. Zool. Stat. Neapel, Bd. vii. Taf. xxiv. fig. 14.

fibres which connected the inner ends of the vanishing skeleton. Externally are circular fibres, which pass downward to a firm connective-tissue area at each side of the massive ventral hypoderm. This great muscular sheet is most massive below, where it supports the origins of the great nerve-trunks. At first no differentiation of the sheet is observable; then pale connective-tissue fibres appear in its middle opposite the upper end of the nerve-masses, and in this an aperture appears, its cavity being surrounded by stained granules, and now it is seen that there are two longitudinal muscles, an upper and somewhat smaller rounded muscle, which projects dorsally on each side of the median groove, and a larger ovoid muscle at the outer side of the nerve-trunk, the two being separated on each side by an increasing coelomic area. The two dorsal muscles are separated by a space, crossed by the circular fibres of the body-wall, and others passing from the inner edge of the muscle and from the six or more vertical bands from the alimentary canal. The hypoderm covering the prominence of these muscles dorsally is specially thickened. The second or ventral pair of muscles are still lateral in position, have the circular fibres, basement-tissue, and hypoderm externally, the nerve-cords and neuroglia internally, and connective-tissue bands and the hypoderm below. The dorsal muscles remain more or less rounded in section (Pl. II. figs. 8 & 9, *dm.*), but the ventral muscles become somewhat longer, more oblique in position, and the nerve-cords now lie below their inner edge inferiorly. Their elongation and obliquity increase in the following sections, for they assume a spindle-like outline, their limiting fibres fusing across the middle line with each other and with those from the vertical bands and those surrounding the gut, whilst the nerve-cords now lie below this fibrous isthmus, with a small neural canal in the neuroglia of their upper and inner border. The dorsal muscles are still rounded or ovoid, separated by a considerable interval in the middle line and wholly dorsal in position, but they by-and-by become pear-shaped in section, pointed mid-dorsally, and thicker externally; moreover, they slope a little downward and laterally. The ventral muscles stretch upward almost to the dorsal bristle-tuft, and are thus longer than the former (Pl. II. fig. 8, *vm.*)—indeed, their mass exceeds that of the dorsal, a condition so different from that in *Pomatocerus*. The dorsal muscles do not meet in the middle line, though thinned like the ventral in expansion of the body-cavity, and they are still less in bulk

than the ventral. The oblique are long and slender, and are fixed over the outer part of the nerve-trunks.

Passing backward, in the anterior region, the dorsal muscles increase in bulk and pass further downward, the dorsal arch of the body being better developed, and the feet having taken a lateral position somewhat below the middle line. A median hiatus still occurs dorsally, and the muscles increase in thickness from this downward until reaching the blunt cone inferiorly. The ventral longitudinal muscles are sausage-shaped in section and now not half the bulk of the dorsal.

In the middle of the body of *Bispira* the walls have assumed the normal arrangement, the hypoderm being thin dorsally, thickened laterally, especially on the processes, and considerably diminished (from that in the front) in the mid-ventral line, the ventral area in section being that of a gracefully curved spindle, massive in the middle below the nerves, tapering off at each side, and again having thickened glandular areas in the lateral region with its processes. The dorsal longitudinal muscles are larger, somewhat thinned toward the dorsal middle line, where there is no distinct hiatus at the attachment of the mesentery, and the curve on each side increases in breadth to the lateral processes, where it bends slightly inward, and in some a slight median projection or keel occurs to which the median mesentery is attached. These muscles are lined by the coelomic cells with nuclei. The fasciculi in section are fibrillar, and they abut externally on the somewhat thin circular coat and internally on the coelomic surface. The ventral longitudinal muscles are less in bulk and more compact, but have similar fasciculi, each having a blunt point in section sloped upward and inward at the nerve-cord, slightly tapered and rounded at the external edge. In the interganglionic areas the nerve-cords have the support of the muscle on each side, the inner end often rising above them, and a deep hollow, in which the blood-vessel and its mesentery lie, between them. The neural canals are slightly larger than in front, an additional smaller canal in one case being within the larger on the right, and the investment of each is firm, with a few nuclei, and the usual coagulable contents. They occupy the upper and inner region of each trunk, though a small one occasionally is seen toward the lower border of the cord at the ganglia. The alternation of the slender ventral mesentery with its pigmented cells free in the coelom, and the massive tunnel of crossed fibres with the vessel and its cells inside, and others along the coelomic wall adjoining

still continues. The gut in the middle of the body is capable of great dilatation, and there is a slight separation of the dorsal longitudinal fibres in the mid-dorsal line, but the fasciculi are similar to those in front, and the muscles are broader—that is, stretch further downward. On the other hand, the ventral muscles are more compact, and the hypoderm in the mid-ventral arc has diminished and shows a furrow (“copragogue”) in the centre, and the sides project a little. The area of the nerve-cords in section is smaller, and the neural canals are proportionally larger. The same alternation of the muscular arches and tunnels with the free mesentery and its vessel occurs, but the ventral longitudinal muscles are thicker, their transverse diameter less, and their inner ends rise much above the nerve-cords, though these ends are thinner than the outer in section. The dorsal longitudinal muscles have attained great preponderance in bulk. In this region muscular fibres pass downward by the side of the gut and from the inner border of the lower mass of the dorsal longitudinal muscles, and cause, by passing through the fasciculi of the ventral sheet, a differentiation into an inner and outer belt at intervals.

Posteriorly the chief changes are the diminution and flattening of the body-wall, the great lateral expansion of the dorsal longitudinal muscles, so that each has a clavate outline in section, and a median hiatus, to which the mesentery goes, is present. The ventral muscles have proportionally increased in bulk and each is also clavate in section, the broad end being exterior, but they do not project above the great nerve-cords as in the middle region of the body. One of the most evident changes is the appearance of vertical bands of muscles which connect the dorsal with the ventral longitudinal muscles on each side of the alimentary canal, and they penetrate the fasciculi in both to the basement-membrane. The nerves and the neural canals are likewise diminished. Toward the tip of the tail an increase in the hypoderm takes place all round, the shrunken muscles rendering this more conspicuous, the dorsal longitudinal thinning off in the middle line much more than the ventral, so that the gut occupies the dorsal arch, whilst a thick mass of hypoderm occurs ventrally.

The muscles of the spines and bristles follow the same plan throughout, forming a fan-like or radiating series in each case.

Bristles.—When the setigerous process in the middle of the body is cut at right angles to its long axis two groups of bristles are found, a more compact series arranged in a

somewhat spiral manner, and an outer series forming a single curve, the larger bristles in this case being above and the smaller at the ventral end.

Circulation.—In transverse sections from the tip of the branchial fan backward it is found that a clear space, it may be with a translucent coagulum in the centre, appears on the inner curve of each fan dorsally and soon is surrounded by a well-defined nucleated wall. Passing backward the trunk has a curved lamina attached to it about the level of the fused branchial filaments, and then it occupies a larger internal lamella, with the curved membrane distally. Before the chordoid skeleton appears the two trunks are imbedded in the folds, which by-and-by lead to the mouth, being situated on each side of the median fissure (Pl. I. fig. 2, *bv.*), when only slight crenations mark the incipient filaments with their chordoid skeleton, the central chordoid mass having disappeared. These trunks would seem to arise from the division of the dorsal vessel anteriorly, but the sections of the region did not afford absolute proof. Moreover, it has to be noted that, if these are vessels, their contents are devoid of the minute corpuscles present in the trunks elsewhere. Anteriorly the dorsal blood-vessel splits into two great trunks for the branchial fan, and each of these at the level of the chordoid skeleton divides into a series for the filaments, the whole in section having the aspect of a rosette (Pl. I. fig. 2, *bv.*). In the middle of the body the dorsal vessel has disappeared, and a plexus or blood-sinus surrounds the gut, whilst the ventral vessel remains as before; and this condition remains to the posterior end.

In a series of sections of a large example in which the thoracic glands were unusually spacious, but which (preparation) had been overheated and damaged, deeply stained granular masses occurred inside the membranous sheath around the gullet, such probably representing the blood in the large sinus, though it might be mistaken for masses of sperms.

At the level of the brain in transverse section the ventral attachment of the collar occurs on each side of the central glandular area, the cuticle and hypoderm of the body-wall bending outward and ensheathing the collar, that part of it, however, covering the central glandular area being much more cellular and granular as well as slightly thicker than the rest. Between the two layers of hypoderm the collar has connective-tissue fibres, cells, and probably muscular fibres, though the latter were not differentiated. The flaps

on the sides of the dorsal furrows have the same structure and all are modifications of the wall of the body.

Alimentary Canal.—The aperture of the mouth, fed by the grooves from the branchial fan, besides those elsewhere described, and with its dorsal transverse fissure and the two lateral folds or lappets on each side below, soon assumes in section the form of a transverse slit, the dorsal epithelial wall of which is boldly scalloped or crenate, with two projections in the middle line, whilst the ventral is two-lobed—two prominent lobes or projections occurring on each side of the central fissure. Then, passing backward, the canal forms a long transverse or slightly fusiform slit, its epithelial surface becoming at the same time less dense, whilst various mesenterial strands are attached to its outer wall; but soon the epithelial lining diminishes in depth and the canal becomes more capacious—shorter in transverse and longer in vertical diameter; its walls increasing in thickness, and its muscular and mesenterial strands more numerous. Thereafter its inner lining is thrown into narrow longitudinal ridges, and strong muscular fibres are attached to its outer surface. The great increase of the mucous lining and the diminution of the diameter of the canal cause the organ in section to be ovoid or even rounded, the entire area being occupied by the folds of the inner lining and the basement-tissue—circular and radiating fibres externally giving firmness to the rounded canal (Pl. I. fig. 1, *d.*). Then the mucous folds change their character, and the inner lining is thrown into slightly arborescent ridges in transverse section, somewhat after the fashion of the gizzard of certain Orthoptera, but it is not chitinous. Behind this, though still in the anterior or “thoracic” region, the canal retains the bold longitudinal ridges of the mucous surface, though they are less arborescent; the suspensory mesentery from the mid-dorsal arch is short and strong, and the walls of the gut are massive, since, besides the coats formerly mentioned, a reticulated connective-tissue layer with vascular spaces, as well as a chlorogogenous coat, surround it. Besides, it is further clasped by powerful vertical bands passing on each side from the dorsal longitudinal muscles to the area of the nerve-cords (Pl. II. fig. 8). The ventral blood-vessel lies in the thick investment immediately beneath it, and a complicated plexus of muscular and connective-tissue fibres takes place beneath the canal and above the ventral vessel in various sections at intervals. Posteriorly, the canal considerably diminishes and its internal surface is

marked by complex folds. Dorsally and externally is the median mesentery, whilst inferiorly is the ventral mesentery enclosing the blood-vessel, and at intervals the plexus of muscular fibres from the oblique muscles and the gut itself, making the arch over the ventral vessel.

Thoracic Glands.—The thoracic glands, or anterior segmental organs of some, have been the subject of various interpretations. Thus Ehrenberg * in *Amphicora sabella* and Grube in *Spirographis spallanzani* thought them reproductive organs. Oscar Schmidt † more or less followed this interpretation, though he associated them also with an excretory function. He describes them as two short sacs opposite the first bristle-bundle in *Amphicora mediterranea*, each with a duct leading obliquely forward to join its fellow and to open in the mid-dorsal line behind the branchiæ. Williams, again, did not allude to these organs, but located the segmental organs of Sabellids and Serpulids in every abdominal segment, each with an external and an internal opening. Leydig and Huxley (the latter in *Filograna*) added little more than a notice of them. De Quatrefages considered them in the Serpulids as blind hepatic sacs connected with the stomach. Claparède (1870) thought them modified segmental organs which in the Serpulids secreted mucus, the ordinary segmental organs occurring in all the abdominal segments of such as *Psymobranchus*. Cosmovici interpreted them as excretory organs or "Organs of Bojanus"; whilst the segmental organs in the posterior region transmitted the ova and sperms. Langerhans termed them head-glands in *Sabella* (*Potamilla*) *stichophthalmus* and *Euchone rosea*, and that they opened dorsally. A. G. Bourne ‡ (1883) considered these organs in *Haplobranchus* tubiparous glands or modified nephridia, and he mentions no ducts.

In his account of the segmental organs of *Branchiomma* Brunotte § describes, after Claparède, the thoracic glands as thoracic segmental organs, and situated in the first and second segments, thus being less developed than in *Spirographis spallanzani*, and even than in *Chatozone* and *Myxicola*, the former species having them in all the thoracic segments, the latter in more than two segments. The author interprets their structure as glands formed by the volutions of two tubes, and in his figures (pl. i. fig. 31, and pl. ii. fig. 40) shows the cœlom as filled by the coils of these, yet in pl. ii.

* Mitth. Verh. Ges. Nat. Freunde, Berlin, 1836.

† Neue Beiträge Naturges. der Würmer-Reise nach Faror, 1848, Jena.

‡ Quart. Journ. Micros. Soc. vol. xxiii. p. 168.

§ Recherches Anat. Branchiomma, p. 59 (1888).

fig. 38 only the section of a single tube on each side is indicated. This interpretation shows certain differences from the arrangement in *Bispira*. Brunotte's view that the walls of these tubes (individual folds) are specially arranged holds only good in *Bispira*, so far as it refers to folds of the appendicular duct posteriorly (Pl. II. fig. 11, *tg.*). The author is inclined to think that these thoracic segmental organs represent the series found in other forms, and are probably homologous with the longitudinal canal in *Lanice*.

The thoracic glands (anterior nephridia) in *Bispira* and other Sabellids follow a different arrangement from those in the Serpulids, *e. g.* *Pomatocerus*, which have their widest part anteriorly and diminish in their progress backward to a blind end. In longitudinal section these glands fill the coelomic spaces of the first two segments in *Bispira*, which thus agrees with *Branchiomma* as described by Brunotte, though their convolutions would appear to be larger, such depending to a certain extent on the degree of contraction or expansion. In the serial (transverse) sections from the front the first trace observed is a small tube with pigmented walls situated about the level of the upper arch of the gullet, between the approximated dorsal and ventral longitudinal muscles, and it is imbedded in muscular fibres stretching from the gullet to the body-wall. Such represents the anterior duct of each side, thus corresponding to the arrangement in the Serpulids. The thoracic gland increases gradually in size and passes downward to the exterior of the oesophagus, resting on a plate of muscle passing outward to the wall and cutting off a coelomic space above it on each side. Here the small tube has fixed to it a loop of vesicular and cellulo-granular tissue which seems akin to the chloragogenous investment of the gut, the cells and vesicles hanging on a thin mesenterial tissue in groups (Pl. II. fig. 11, *chl.*). The structure of the gland in section is similar to that in the Serpulids, but the walls are, perhaps, less massive than in *Pomatocerus*, though of considerable thickness, the tough external layer having muscular fibres within it and the epithelial layer being largely developed. With the increase of the coelomic space the gland on each side moves downward and the cellular loop (really a tube) enlarges, and the sections of the gland lie within the ring of this tissue. Then sections of two glandular tubes appear, as if the organ had become bifid, both connected with the granular cellular tissue, the vesicles and cells projecting into the ring from the limiting membrane externally, and they form a thicker and more definite layer.

Moreover, that part of the wall of the vesicular tunnel adjoining the gut-wall applies itself to it, whilst the outer part of the cellular structure forms loops in connection with the thoracic glands, which when the sides are flattened present in section the aspect of a tube, as shown by Brunotte (his pl. i. fig. 21). Masses of cells with brown pigment occur on various parts of this cellular membrane, and the transparent cells themselves are often grouped near the oblique muscles as they pass to their insertion above and to the exterior border of the great nerve-trunks. A conspicuous feature at this level is the occurrence of a comparatively large aperture through the body-wall just below the bristle-tuft, the finished nature of which shows that it is a permanent structure, but whether in connection with the thoracic glands or otherwise the imperfection of the sections does not enable a decision to be made. The area of the thoracic glands is much larger than in front, the reverse of the condition in the Serpulids, and they form complex structures by folding or division. The complexity of these glands is best shown in longitudinal sections, and they fill up the coelomic space in the first two segments. Brunotte describes them as double. Further, toward the posterior part of the glands one tube is found in section to the outer side of the fibres of the oblique muscle and has considerably diminished. Transverse sections of the smaller tubes present an investing membrane lined by nucleated cells probably with internal cilia, all the parts, including the thoracic gland proper, being more delicate and transparent than in *Pomatocerus*. Then the gland increases in area and shows various folds or pouches, and the vesicular and cellular strands become abundant, the main gland, to which these are attached, often presenting septa dividing it into two chambers. Finally, the gland and its tubular appendages disappear, only the translucent botryoidal tissue being left in strands connected with the mid-ventral region, and passing up to the dorsal longitudinal muscles. Besides the vesicles and cells attached to the membrane a small tube is seen in section, and, moreover, it is clear that this tissue is identical in structure with that attached to the wall of the gut, and nucleated strands pass beneath the canal to be attached to it above the ventral blood-vessel, probably separated from the gut-wall during preparation. Further backward the wall of the alimentary canal is free from this tissue, only a slight development of it taking place posteriorly.

Segmental Organs.—In the middle of the body a folded tube with transparent nucleated cells lies in the space above

the outer ends of the ventral longitudinal muscle. The nuclei along the sides of the tube stain deeply, thus outlining the canal which curves downward and outward and opens below the bristle-tuft external to the outer edge of the ventral muscle (Pl. II. fig. 13, *so.*). Nothing was seen of its internal connections except an occasional wider section. Separate masses of the deeply stained cells were noticed here and there, as if from folding or lobulation of the main tube, which in some cases appeared to form loops, and the vascular supply is abundant. Occasionally masses of minute cells were present toward the middle, attached by mesenteries to the other parts of the organs, and in section such were sometimes circular. The ducts seem to be smaller and longer posteriorly, and in some cases did not appear to be functional, especially toward the tip of the tail. Further investigations in this region are, however, necessary. When the nephridial tubes are cut longitudinally the nuclei ranged along each wall are conspicuous.

In *Amphiglena mediterranea* the chordoid arch supporting the branchiæ is narrow and composed of but two large cells from side to side of the middle of the bar, which is boldly curved ventrally at each end, whilst the central bar is concave dorsally beneath the dorsal groove—the whole having the form of certain bows, especially as a blunt conical projection occurs at each end of the transverse bar where the cells also are increased. The mouth in section in this region forms a vertical slit, bifid dorsally—that is, leaving a median pointed cone dorsally. The cephalic ganglia occupy a similar position to that of the typical forms. The pharynx soon forms a thick-walled tube rounded in section, and filled with granules and spicules, the mesentery holding the dorsal vessel above and the ventral inferiorly, the latter being close to the two nerve-cords which lie on the inner surface of the massive and continuous hypodermic glandular area of the region and at some distance from each other, the comparatively massive ventral longitudinal muscles being as yet to their outer border and wide apart, whilst the ventral blood-vessel is placed between them. No neural canals are present. Proceeding backward the ventral longitudinal muscles, which are now extended and comparatively thin, send their inner edges into the median groove formed in the centre of the ventral hypodermic mass, the nerve-cords, which were very indistinct in the preparations, apparently lying at the sides of the fissure, in the middle of which is the mesentery from the alimentary canal fixed to the distal end of the fissure. About the level of the nerve-cords is the

ventral blood-vessel which has remarkably thick walls, so that at first sight the mass resembles the halves of a narrow elliptical ganglion or flattened cord, after the character of that in *Arenicola*, since the actual cords are difficult to recognize. The thickness of the walls of the vascular trunk would indicate special contractility in this region. The hypoderm is thus divided into lateral lobes with a slight median ventral ridge, the whole being glandular.

The body-wall in *Dasychone dalyelli* (*argus*) has externally the cuticle and a thick hypoderm, and there is a glandular ventral belt of great depth as in *Sabella*, with a median notch. The circular muscular coat appears to be comparatively thin, though continuous. The dorsal longitudinal muscles are in section rather broad and thin, the thickest end being external, and a hiatus occurs in the mid-dorsal line. A considerable gap exists between the ventral longitudinal muscles, which are about the thickness of the dorsal, though narrower, and without curvature, apparently from the feebleness of the oblique muscles. At intervals somewhat powerful muscular bands slope downward and inward, to be attached to the complex area above the nerve-cords, but the system is less marked than in *Sabella*. The alimentary canal has its median dorsal and median ventral mesenteries. The nerve-trunks lie more distinctly under the inner edge of each ventral longitudinal muscle, and no neural canal is present. The fibres of the circular and oblique appear to cross between them, and from the trunks fibres radiate into the glandular coat outside. The ventral longitudinal muscular layer is often broken up into several fasciculi.

The structure of the body-wall in *Chone infundibuliformis*, Kröyer, introduces a new type into the series, were it only for the remarkably coiled arrangement of the muscular fasciculi of the longitudinal muscles in transverse section. The cuticle covers a hypoderm well developed and highly glandular throughout, the long cylindrical cells being characteristic, especially when slight softening of this coat occurs. In the mid-dorsal line is a deep groove, and its bottom and sides show a somewhat finer granular structure, so that it may be a more sensitive area than the general surface. A decided thickening of the hypoderm takes place in the mid-ventral line, and it tapers to the normal thickness in the ventro-lateral region. The circular muscular coat is well developed and continuous, modifications occurring at each foot. The dorsal longitudinal muscles are largely developed, and, like the ventral in section, are in two concentrically arranged bands, the outer layer, however, extending

over the dorsum of both. The median band is somewhat triangular with the pointed end internally, the outer is ovoid, and in the hiatus between the muscles of opposite sides the alimentary canal is suspended, and so closely that no mesentery is apparent—indeed, it would seem that the muscular fibres which pass from the circular coat into its walls form the suspensory apparatus. Ventrally the longitudinal muscles likewise form in transverse section two areas, in this case somewhat heart-shaped, the base of each being central, the apex external, and the outer (ventral) fillet of the muscle likewise extends over both areas. The inner edge of each muscle is separated by a considerable gap, in which lie the nerve-trunks which rest in a granular neuroglia, with the neurilemma and the circular muscular coat externally, whilst to their upper edge are attached strands from the alimentary canal. The two cords are surrounded by a sheath or neurilemma, and at the upper and inner angle is a small neural canal. At the ganglia the neurilemma is confined to the outer surface. In the mid-ventral line beneath them is a granular mass (in section) of neuroglia, and a trace also appears at each side, whilst in the region of the separate cords this inferior granular structure is thicker in the centre and tapers off laterally. On each side of the strands from the alimentary canal is a foliate granular mass (male elements?), whilst between the strands is the ventral blood-vessel. Large vascular trunks or sinuses occur along the wall of the alimentary canal. The fan-like arrangement of the long hooks is well shown in such sections.

Somewhat behind the foregoing the mid-dorsal groove becomes only a slight depression, though the hypoderm retains the same character as in front and the cuticular surface appears to be ciliated. The hypoderm now forms a coat of nearly equal depth all over, though there is still a slight thickening in the mid-ventral line due apparently to increase in the basement-substance as well as in the hypoderm proper. The circular coat has increased in strength, the suspensory fibres for the alimentary canal are longer, and the canal itself shows both circular and longitudinal fibres, whilst the folds of the mucous surface are sometimes so arranged in the empty organ as to interlock. Strong fibres at intervals pass from the dorsal to the ventral region—grasping the alimentary canal at each side, and being attached to the fibres, including those of the oblique muscles, which form a complex around the ventral blood-vessel and over the nerve-cords. The latter have now, at

their upper part, a larger neural canal which in some sections exceeds in bulk the main mass of each nerve, as in Allen's *Pæcilochaetus* *. The neuroglia external to the trunks has increased. The condition of the dorsal and ventral longitudinal muscles is the same as in front, the coiled arrangement of the fasciculi being conspicuous in section.

In a section about half an inch from the tip of the tail, no evident dorsal notch occurs in the hypoderm, but a deep groove exists between the thickened hypoderm on each side of the mid-ventral line. The circular muscular coat is still conspicuous. Each moiety of the dorsal longitudinal muscle is now separate, the outer coil dorsally leading externally to several folds wedged between the moieties, the inner being rounded and smaller than the outer moiety. A strong series of muscular fibres leaves the dorsum, joins the oblique, and passes to the ventral border on the outer side of the nerve-trunks. The arrangement of the coils in the ventral longitudinal muscles in section is as in front, viz., the outer or ventral band envelops both moieties which are irregularly rounded and the inner is the smaller. The alimentary canal is small, firm, and rounded, highly vascular, and fixed by the mesenteries as in front, its circular muscular coat being conspicuous. The nerve-cords have a considerable mass of neuroglia externally—that is, between them and the circular muscular coat. A small neural canal occurs at the upper and inner border of each, the nerve-tissue completely surrounding it.

In the *Dialychone acustica* of Claparède †, the two statocysts (otocysts) in the first segment are well developed, but the chief interest, in connection with the present remarks, is the characteristically coiled condition of both dorsal and ventral longitudinal muscles (on section) from the anterior end backward. The large size of the skeletogenous reticulations and their numerous nuclei are also features of note. In a female large ova occurred in the anterior thoracic region.

The body-wall in *Othonia* conforms to the general type of the family. In those having the body-cavity distended with comparatively large ova the muscular layers are somewhat thinner, and the alimentary canal forms an ellipse held by the dorsal and ventral mesenteries, the minute nerve-cords apparently having no neural canals.

In *Euchone analis* (about $\frac{1}{6}$ of an inch) from the front the

* Journ. M. B. A. vol. xlviii. p. 105.

† Annal. Chét. Neap. p. 432, pl. xxx. fig. 3.

hypoderm is greatly developed on the ventral surface, thinning off in the lateral regions, and with a slight groove mid-dorsally. The circular muscular coat is fairly developed all round. The dorsal longitudinal muscles form a continuous loop in transverse section, the broader end of each being external, and the short mesenterial attachment of the alimentary canal separates each muscle in the mid-dorsal line. The folds of the ventral longitudinal muscles are also apparently continuous in section, both these and the dorsal being somewhat lappet-shaped, the inner end being pointed, the internal fold of the muscles terminating before reaching the point in each case. The oblique muscles seem to be feeble and indistinct, each appearing as a thread-like process along the inner border of the ventral longitudinal muscle, and being attached over each nerve-cord. The alimentary canal (gullet) is large in this region, and has a firm exterior with circular and longitudinal muscular fibres, and a thick mucous coat, the nerve-cords are comparatively small and lie in the intervals between the ganglia in the middle line below the attachment of the mesentery from the gut. Externally are a mass of neuroglia, the circular muscular coat, and the much thickened hypoderm of the ventral surface, which shows no median groove in this region. The nerve-area is considerably larger when a ganglion is severed. The canal is ensheathed by a firm mesentery fixed on each side over the nerve-cords. A small canal occurs in the median line above the nerve-cords, and the gonads are at each side. The sheath of the alimentary canal is close to the vessel, thus differing from the usual condition of a free space between loose mesenteries.

A little ($\frac{1}{6}$ in.) behind the foregoing the ventral surface is marked by a deep groove, so that the thick hypoderm forms a crescentic mass on each side. The alimentary canal is much enlarged, and its lumen filled with folds of mucous membrane. The dorsal and ventral longitudinal muscles have the same structure in section.

Toward the posterior region of the body, whilst at first the ventral muscles indicate no change, the dorsal loop presents a hiatus at the ventral edge on each side of the middle line, from which apparently the homologues of the oblique muscles pass, the outer fold being enlarged next the fissure; such is the condition at $\frac{1}{5}$ of an inch from the tip of the tail. The whole aspect of each muscle, however, alters at about $\frac{1}{3}$ of an inch from the tip of the tail. Each dorsal muscle forms in section a continuous thick arch superiorly, the inner end bending downward and forming a

coil of a turn and a half, whilst the outer and thicker end does the same. Each ventral muscle, on the other hand, makes a single coil of one turn and a half from its outer end, and thus forms a contrast with the double coil in each dorsal. The small gut lies in the centre, fixed by the ordinary mesenteries. The ventral groove is now open and the ventral hypoderm is considerably thinner.

Euchone would thus appear to show a more primitive type than *Chone*, since anteriorly the dorsal and ventral longitudinal muscles have a simple loop, after the manner of *Nereis*, whereas posteriorly the coiled type of muscle has made its appearance. It is also in contrast with *Dialychone* of Claparède, in which the coiled muscles begin at the anterior end.

2. *On some Points in the Structure of the Serpulidæ, chiefly of Pomatocerus triqueter, L.*

Less was accomplished in the minute structure of the Serpulids than in the Sabellids until Claparède took up the subject in his 'Recherches sur la structure des Annélides Sédentaires'*. He dealt in this group for the most part with *Protula intestinum*, in which he found the hypoderm greatly developed on the ventral surface and richly vascular. In *P. infundibulum* he noted the pennate arrangement of the longitudinal muscles in section, and pointed out that the intestinal sinus is lodged between the epithelial coat and the circular muscular fibres, and that giant fibres occur in its great nerve-cord and œsophageal commissures. He thought that in *Psygmorebranchus protensus* the distant halves of the ganglionic cord denoted inferiority, especially as in larval annelids this condition is more marked than in the adult. Three pairs of ganglia occur in the thoracic region, the largest being the second, and they are united by transverse commissures. He stated that in the Serpulids only a single pair of segmental organs occurred, viz., in the thorax, and that they gave exit to the reproductive elements. In his description and figures the voluminous folds of the organ are indicated, and he considered that, by filling up the body-cavity, they conducted to the solidity of the region.

Schenk † (1874) gave a brief account of the structure of the body-wall in *Serpula uncinata*. In his transverse sections he appears to have overlooked the great nerve-trunks, though traces of these occur in his figures.

* Posthumously published in 1873.

† Sitzb. K. Akad. Wiss. Wien, Bd. lxx. pp. 1, 2, pl. i.

Eugen Lee * (1912) describes the blood-vessels and sinuses in *Protula*, *Vermilia*, and other Serpulids:—The main channels, he states, are determined by the metamerization and differentiation of mesodermic bands which arise from pole-cells. The gaps between the splanchnopleure and intestinal epithelium, or between the neural and hæmal mesenteries and septa, give rise to channels for the nutrient fluid diffusing through the epithelium of the gut. The channels at first have no proper walls. The walls of the visceral sinus and dorsal and ventral vessels are due to muscular differentiation of the splanchnopleure. The lumen of other blood-channels is interseptal and closed off by peritoneal walls from the cœlom.

As indicated in the remarks on *Bispira*, E. Meyer has devoted much attention to the structure of the Serpulids, which he contrasted chiefly with the Hermellidæ. He also followed the development of the thoracic nephridia in *Psygmodranchus protensus*, and went minutely into the processes and collar of the anterior region. His observations on the various organs, though somewhat diffuse, are of much interest. The Sabellids were included with the Eriographididæ and Serpulidæ under his Serpulidæ.

A prominent feature in the anterior body-wall of *Protula tubularia*, Mont., is the great size of the dorsal longitudinal muscles, thus agreeing with *Pomatocerus*. The cuticle and hypoderm are well developed throughout, whilst on the ventral region anteriorly is a thick glandular investment with numerous small blood-vessels at its inner edge, a condition probably associated with a special secretion. In order to follow the arrangement of the muscle it is necessary to examine the extreme anterior end, where the dorsal surface has a deep groove in the middle line, the rounded parts on each side indicating the projecting dorsal muscles, which already are large. The lateral regions are formed by extensions of the body-wall, and bear the bristles in each segment. A thin circular coat lies under the hypoderm external to the dorsal longitudinal muscles, and it extends into the lateral regions. Sections of the posterior end of the ganglia lie below the great muscles, and in the mid-ventral line is an elongated area between them. The alimentary canal is clasped by strong circular muscular fibres, the circular muscular coat of the body-wall being external to it. In the middle line numerous vertical fibres pass

* Jen. Zeitsch. Natur. xlviii. pp. 432-78, with 6 plates.

from the alimentary canal to the mid-dorsal groove, and they by-and-by separate the nervous masses on each side. A projecting process, probably glandular, occurs on each side of the middle line ventrally, and the hypoderm is specially thickened toward its exterior. At the outer edge of the space lying below and external to the great dorsal muscle on each side is a muscular band, but such is distinct from the ventral longitudinal muscles which in section appear as small rounded areas on each side of the middle line, and with the nerve-trunks and the great neural canals at their inner borders. Proceeding backward the ventral longitudinal muscles gradually separate from each other and become flattened in section, thus carrying the nerve-trunks further from the middle line, the ventral blood-vessel lying in the centre with the alimentary canal above it grasped between the massive dorsal longitudinal muscles. In the long space between the ventral muscles and the nerve-cords are several small fascicules of longitudinal muscular fibres, and large processes of the alimentary canal appear above the inner edges of the ventral longitudinal muscles. The vascularity of the inner region of the hypoderm is noteworthy. Further backward the oesophageal region diminishes, whilst a process of the gut appears above it, and the two processes beneath the oesophageal chamber have moved inward toward the ventral blood-vessel, whilst the dorsal longitudinal muscles are somewhat further apart. The ventral longitudinal muscles are larger and are elongate-ovoid in transverse section with the nerve-cords at their inner edges. They are separated by the processes of the gut and the ventral blood-vessel.

In the posterior region a change has taken place in the structure of the body-wall. The dorsal longitudinal muscles have now spread out into thick plates on each side of the middle line, and in the lateral region end in a massive rounded area of folded muscular fasciculi, which in section show a pennate or feathered aspect. A large alimentary canal occupies the centre. The ventral longitudinal muscles are still proportionally small, forming, in section, elongated plates somewhat thicker externally, and with the nerve-cords and their large neural canals at the inner edge. They are separated from each other by the ventral blood-vessel, which is in contact with the gut superiorly. The inner edges of the ventral muscles have thus moved nearer the middle line. The ventral hypoderm now presents the same structure as the dorsal.

The hypoderm in *Serpula vermicularis* is firmer than in

Protula, and anteriorly the ventral hypoderm is non-vascular. Within is the circular coat which extends all round, and presents special developments at the foot. The dorsal longitudinal muscles form massive kidney-shaped lobes in transverse section, separated in the mid-dorsal line by the alimentary canal and its short mesentery and by a vessel at each side. These muscles extend from the dorsal almost to the ventral edge, and are proportionally larger than in *Protula*. On the other hand, the ventral longitudinal are smaller, and in section are short spindle-shaped bands widely separated from each other, and with the nerve-cord and its large neural canal at the inner edge. Between the latter stretches a thin but continuous layer of longitudinal fibres, having the circular muscular coat externally and the ventral blood-vessel internally, with the muscular aponeurosis on each side, as well as certain fibres from the slender oblique, which passes the cord and is attached over the thin muscular layer. The alimentary canal has a thick investment of circular muscular fibres with groups of inner longitudinal and a richly folded mucous lining. It stretches from the dorsal surface to the ventral blood-vessel. The dorsal fold arising from the foot is hollow distally.

An interesting feature is the presence of a peri-intestinal sinus in the outer wall of the alimentary canal and extending from the posterior region forward to the œsophagus, and which takes the place of the dorsal vessel of other forms, and the same arrangement occurs in the Ariciidæ, Chætopteridæ, Ammocharidæ, Sabellidæ*, and other families.

The peri-intestinal sinus surrounds the canal throughout the greater part of its extent, and in *Eupomatus elegans* Prof. Haswell states that the sinus ends in front of the œsophageal region in a short wide dorsal sinus or cardiac sac, from which a pair of vessels pass to each branchial base, "where it (each) unites with a smaller branch from the ventral vessel to form the common branchial vessel," which makes a curve—giving off a branch to each branchia and the operculum and pseudo-operculum. "The ventral vessel is a distinct wide trunk, which is continued along the body, and in front communicates with the branches from the dorsal sinus. The capillaries of the collar and flaps receive blood from the ventral vessel, and, as in the branchiæ, the circulation is to-and-fro." The blood which enters the peri-intestinal sinus by the segmental vessels is carried forward

* Haswell, Proc. Linn. Soc. N.S.W. vol. ix. pp. 1-27 (sep. copy).

by peristaltic contractions to the cardiac sac, whence it is driven at intervals forward to the common branchial vessels and by the separate trunks to the tips of the branchiæ. It returns by the same course and enters the lateral ventral trunks, and passes to the ventral vessel, by which it is distributed to the collar and the body generally" (Haswell). In *Pomatocerus* the abdominal region possesses the peri-intestinal vessel and a minute ventral trunk. Anteriorly the former splits into a large dorsal vessel or cardiac sac and about 16 smaller vessels, which run on the wall of the alimentary canal. Further forward the peri-intestinal vessels join the dorsal trunk, thus making two main trunks, a large dorsal and a small ventral. Then the dorsal bifurcates into the two branchial, and so does the ventral, but Prof. Haswell was uncertain whether the latter communicated with the former as in *Eupomatus*. All the vessels possess a muscular wall, and the blood in the majority is of a light green colour, and contains certain clear oval bodies probably derived from the epithelial lining of the vessels.

A pair of thoracic glands exist in this group as in the Sabellidæ. In *Eupomatus* and *Serpula* each has the form of a brown body with its long axis directed longitudinally, the posterior part with thinner clearer walls and an anterior dark brown folded part. No opening into the cœlom was made out by Prof. Haswell. In front the gland is continued into the ciliated duct, which passes almost directly inward to meet its fellow in the middle line, the common duct going straight forward to open ventrally (dorsally) between the bases of the branchiæ. The gland is lined by large, granular, nucleated cells, each furnished with a flagellum at its apex. Haswell found the "true" segmental organs in all the abdominal segments, viz., delicate pyriform sacs ciliated internally, and opening externally on the sides of the segments by slit-like apertures having active cilia. No internal aperture could be made out. In *Eupomatus* each in the female contained a group of ova at various stages up to the fully developed egg. These segmental organs alternated with the ovaries. In the males these sacs were always empty.

No feature is more distinctive of the Serpulids in contrast with the Sabellids than the extreme transparency, thinness, and minute serrations of the hooks. As a rule, they approach in shape those of the Ampharetidæ rather than those of the Sabellidæ. The hard, smooth, calcareous nature of the tube probably necessitates a special adaptation of a mobile torus with flexible hooks, the free edge of which is beset with a

multitude of minute processes—probably of great use in fixation. Another structural characteristic is that of the first or collar bristles, which, for example, in the Spirorbids are of specific importance. The absence of tentacles (two of which are present in the Sabellids) and the presence of a calcareous operculum in the Serpulids are distinctive, just as the long branchiæ of the Sabellids are in contrast with the shorter organs in the Serpulids.

The secretion of the tube, as indicated under *Pomatocerus triqueter*, takes place with considerable rapidity—for instance, on the carapace of the shore-crab, on porcelain or stone-vessels and bottles thrown into the sea, and is further proved by observations in confinement. Mr. Arnold Watson thinks it is secreted by the outer side of the collar, since, as soon as the anterior part of the annelid emerges, the collar is folded over the edge of its tube, its two lobes meeting over the mucro. He adds, however, that the formation of a diaphragm in a broken tube shows that other parts may likewise secrete the calcareous matter. As detailed in the structure of the hypoderm, the collar and the free surfaces of the thoracic jacket contain much glandular tissue, as likewise do the lamellæ or elevations for the tori uncinigeri.

Hypoderm.—In the anterior sections of the body-wall of *Pomatocerus triqueter* the dorsal is distinguished from the ventral hypoderm by the intensity of the stain (Ehrlich's Hæmatoxylin and Eosin) * in the latter, viz., from the slight projection below the enlarged base of the dorsal flap or process to that of the opposite side, the glandular tissue, like that of the œsophageal wall, readily absorbing this stain, so much so as to become opaque. The dorsal hypoderm, on the other hand, has only the nuclei tinted near its outer edge, and the inner part of the enlarged base of the dorsal flap shows likewise glandular tissue. The thoracic collar anteriorly (Pl. IV. fig. 21) is somewhat complex in *Pomatocerus triqueter*, having dorsally a large fan-shaped lamella on each side, then a gap between it and the continuous ventral portion of the collar, whilst a small lamella with processes on the edge occurs at the gap, its base having a closer connection with the ventral than the dorsal moiety. This condition of the ventral hypoderm continues backward to the end of the thoracic glands, the lateral processes bearing the hooks being especially glandular. Then the glandular

* I am indebted to Miss Lamont, of the Zoological Department of Edinburgh University, for aid in section-making, my own trained men being on service.

tissue forms a patch on each side of the middle line ventrally, as well as on the edges of the ventro-lateral processes, and thus these form a contrast with the dorsal (branchial) processes. Thereafter (proceeding backward) the glandular tissue is almost absent from the median ventral region, but is highly developed on the ventro-lateral processes; soon, however, it again appears in the ventral plate or fillet, which has glands along its lower edge, a few remaining in the hypoderm of the ventral surface of the body-wall.

So long as the free flap of the thoracic jacket or collar occurs, the glandular tissue in the hypoderm of the ventral edge of the flap is dotted at intervals with glands, and they are also distributed along the ventral hypoderm of the body-wall, but in moderate numbers. As the flap diminishes the ventral median groove of the body-wall becomes deeper, but its hypoderm is thinner than that at the sides (beneath the ventral longitudinal muscles), the glands, however, being continued in it. When the jacket ends, the hypoderm generally is somewhat thinner, the ventral groove rather more shallow, and the glands are but slightly developed, the most conspicuous aggregations being in the lateral thickenings bearing the hooks, so that the region is in marked contrast with the anterior. This description applies to the body-wall as far backward as the valvular region of the alimentary canal.

In the posterior division of the body the glands still occur in the lateral region and on the lamellæ for the hooks, as well as a few along the ventral border, especially on each side of the ventral groove. Very few occur dorsally—indeed, in most sections they are absent from the dorsal arch, only nuclei occurring there.

The hypoderm at the level of the origin of the opercular stalk (Pl. IV. fig. 20) often presents a fan-like arrangement of its long cells, as at *hpe.*, a condition probably due to slight folds in the sections, but such recalls the aspect of some simple sense-organs, *e. g.* eyes, though no pigment is present, only the stout basement-tissue on which the cells rest. That this modified hypoderm in the anterior region performs special functions is evident by contrasting the outer and inner surfaces of the thoracic collar or jacket, also by the massive thickness of some parts, the thinness of others, and the blanks in the layer only invested by cuticle (*hb.*) in the same figure. The almost perfect regularity of the nuclei and the fibroid aspect of the long cells are other features of moment. The blanks (*hb.*) in the hypodermic coating consist of a reticulum of nucleated cells supported internally

by strands of basement-tissue, whilst externally is the cuticle and within it a very thin extension of the hypoderm from each side, only of sufficient depth to contain the abbreviated nuclei continued in close array along it. The general aspect of the reticulum agrees with that found in the central area of the differentiating opercular stalk, and is in contrast with the modified hypoderm above-mentioned.

Thoracic Glands.—In the fresh example two brownish bands lie on each side in front, pointed behind, and increasing in diameter as they go forward. A wide duct from each passes inward, apparently with a slight forward obliquity, to meet its fellow of the opposite side, and then by a common median duct to open dorsally between the bases of the branchiæ. The lateral ducts show large brownish granular glands similar to those lining the interior of the glands proper, but they do not pass forward from the point of junction of those of opposite sides.

The glands in the anterior region of *Pomatocerus triqueter* are first noticeable in transverse sections from the front as somewhat irregular spaces due to folds, for this is their widest region, shortly after the ventral cords leave the brain, and in the lateral region to the upper and outer side of the nerve-trunks. The early stages do not present so definite a cellular lining as subsequently forms, though the cells are present, with processes, apparently of cilia, extending inward from their free edges. Surrounding the cellular lining is a layer of connective tissue with numerous nuclei. The spaces soon unite (proceeding backward) into a large cavity lined with cubical cells, and stretching from the nerve-cord obliquely upward and outward to the bristle-tuft (Pl. V. fig. 26, *tg.*), the processes still projecting from the inner surface of the cellular lining (the flagella mentioned by Prof. Haswell). Externally is a compact cellular mass, *cm.*, with distinct nuclei, and this, from the contraction of the lumen of the organ and its passage toward the ventral aspect, gets above the cavity—touching the basement-membrane of the body-wall. The latter in this region has the comparatively small dorsal muscles separated by a gap, in the middle of which is the mesentery holding the dorsal blood-vessel and the alimentary canal below it. A considerable band of longitudinal muscle (Pl. V. fig. 26, *m.*¹) lies dorsad of the two masses of the dorsal longitudinal, and separated from them by septa. A thin band of longitudinal muscular fibres stretches on each side a short distance to the inner side of the nerve-cord. As the thoracic gland diminishes, its cubical cells and their large nuclei become clearer, the processes still

project from their inner edges, and the duct lies to the ventral or inner edge of the tori and the bristles. When the tube has about 18 cells in its wall (and is therefore small) the glandular or dorso-lateral appendix, *cm.*, is fully twice its diameter, and soon the tube vanishes, leaving only the thin glandular belt within the body-wall. This dorso-lateral appendix appears to be somewhat akin to the multinucleated coelomic bodies described by Prof. Caullery* in *Eunice harassii*, Aud. & Ed. As already mentioned, the ducts from the anterior end show flask-shaped brown granular glands, but the single duct formed by their union is quite pale.

Toward the termination of the thoracic glands, and behind them, the coelomic cavity contains vessels and chloragogenous tissue covered with opaque granular masses, often enveloped in the chloragogenous sheaths. These continue for some distance backward and by-and-by disappear.

Whilst the thoracic glands are still of moderate size—that is, toward their posterior third,—it is noticeable that they are bounded externally by a firm layer of the body-wall ending inferiorly in a free process, which in transverse section is clavate (Pl. V. fig. 28, *p.*). This layer, *ab.*, has rather regularly arranged fibres at right angles to the axis of the body, which stain like the muscles in their neighbourhood, and do not resemble the hypodermic nucleated cells. It has externally the pad or process bearing the hooks, and it terminates ventrally, rather past the middle of the section of the thoracic gland with its appendix, in the free process, the ventral end being pale. The narrow bar, however, proceeding forward, soon enlarges into a thicker layer of prism-like cells with the nuclei at their free surface, thus giving the aspect of a series of punctures at the enlarged outer ends, for the cells, *ce.*, are clavate and minutely granular (Pl. V. fig. 29). This peculiar cellular layer runs upward on the external border of the branchial stalk, the inner layer, continuous with the dorsal hypoderm, presenting quite a different structure, and the nuclei are within their superficial ends (Pl. V. fig. 29). The function of this special cellular development would seem to be in connection with the well-developed hook-pads of the region rather than with the thoracic glands, probably acting as an elastic cushion. The muscular fibres seen in Pl. V. fig. 28, *m.*, are those which move the hook-pad, whilst that structure itself is largely composed of the modified hypodermic cells just described. Hence the appearances of the parts vary

* Compt. rend. Soc. Biol. t. lxxviii. p. 593 (1915)

according to the line of section. Thereafter, the tissue gradually merges into the hook-pad with its superficially arranged glands, and so on throughout the region, the inner or secondary ridge appearing and disappearing in each segment.

The supporting tissue in the anterior region of *Pomatoscerus triqueter* differs from that in the Sabellids. Just as the nerve-cords leave the cephalic ganglia, and whilst still connected by a long and strong commissure, no special supporting tissue is visible. The long, narrow, hypodermic cells of the dorsal wall (Pl. IV. fig. 20, *hpe.*) are indeed of great depth, especially in the middle line, so that when torn they resemble fibres, whilst within the basement-membrane are only the thin circular muscular fibres and the dorsal longitudinal muscles—as yet little developed. As the opercular stalk leaves the body-wall of the region (Pl. IV. fig. 20, *op.*) its central areolar mass joins the other tissues and may stiffen the parts, for as yet the fibres of the dorsal longitudinal muscles are few. Through this mass a bifid nerve-trunk from the cephalic ganglia passes. The remarkable thickness and the appearances of the hypoderm of the region in this species would suggest the view that it may more or less be connected with the function of the special chordoid skeleton of other forms. In this respect the dorsal differs essentially from the ventral hypoderm of the region, which is richly glandular. The muscular tissue at the base of the stalk is reticulated in longitudinal section, as if the sarcolemma formed a network; indeed, reticulation of the muscular fibres themselves would appear to occur, though the trend of most at the base of the stalk is longitudinal.

The projection of the opercular stalk causes asymmetry of the body-wall and of the incipient dorsal longitudinal muscles, for the muscle of the same side considerably increases in size, probably in relation to the movements of the stalk. The body-wall remains asymmetrical after the stalk separates, that side being less than the opposite one, in which, moreover, the slits separating the branchiæ first appear. This asymmetry subsequently disappears in front when the filaments approach separation, but it is a marked feature. Connective-tissue cells fill up the lateral space within the body-wall beyond the region of the cephalic ganglia, but these do not show special chordoid structure. Deeply stained nerve-cells surround the cords and the transverse fibres between them. The enlarged base of each ventral flap of the thoracic jacket has connective-tissue cells similar to those in the lateral region of the body, the flap

being joined to the body-wall by a firm isthmus in the middle line, its two surfaces beyond being structurally differentiated, the inner (that is, next the body-wall) being coated by a thick layer of the long hypodermic cells with the nuclei near the surface, whilst the outer has much shorter cells, the inner ends of which seem to run into the reticulated connective-tissue of the central region. Masses of gland-cells, moreover, occur along the convex margin of the jacket. In the area of the cephalic ganglia the modified hypoderm is thickened in the mid-dorsal line and also laterally so as to form a protection to the organs. Then on the side (generally the left) from which the opercular stalk springs this modified hypoderm bulges out and envelops it (Pl. IV. fig. 20). Further, the glandular nature of the ventral wall diminishes, and a split separating the jacket or collar appears and joins the folded lateral and dorsal flaps, both the inner surface of the collar and the outer of the body-wall being invested by layers of the hypoderm. As soon as the collar becomes free (in section) the entire body-wall, with the exception of a narrow lateral belt on each side, is invested by this modified hypoderm, the thickest parts being the dorso-lateral and mid-dorsal regions; and the origin of the opercular stalk has the same investment, special support being afforded by the adjoining mid-dorsal and lateral enlargements of this modified hypoderm. Proceeding forward the ventro-lateral regions of this coat are considerably thickened, and a deep furrow now cuts off the opercular stalk (Pl. IV. fig. 22). The diminished area of the anterior region is specially stiffened, for in section the greater part of its surface is composed of this modified hypoderm, the only gaps being those of the mouth, the branchial trunks, and a coelomic space. The shape in section is that of a curved dumb-bell (Pl. IV. fig. 23), the narrow median region with the oval slit corresponding to the handle and the enlarged lateral regions to the bells. Instead of the dorsal region having the thick layer of modified hypoderm, it is now the ventral surface, and the band is dilated at each side, after which is a connective-tissue belt, then a band of the modified hypoderm round the bulbous ends, in which by-and-by appear the slits indicating the separation of the branchial filaments. These slits have a regularly arranged cellular investment with distinct nuclei, and they increase in size and number from behind forward. The intermediate region, between the dilated ends of the dumb-bell, has only a thin coating of ordinary hypoderm, and is thus in contrast with the lateral regions. Advancing forward a slit appears

on each side of the vestibule, and thus the enlarged ends of the dumb-bell are more distinctly differentiated from the curved median region with its widening vestibule (Pl. IV. fig. 23). At this level there are four intermediate branchial slits, and the inner on each side is the more elongated, whilst the conical ventral edge of the lateral enlargement is stiffened by a cap of the modified hypodermic tissue. The ventral collar (jacket) has now much diminished in size, but the dorsal edge of the organ still shows a coating of the modified hypoderm. Further forward the collar forms but a small U, the thick layer of its hypoderm being, as formerly, dorsal; the median lamella containing the vestibule is longer, whilst the dilated ends are somewhat crescentic and show six intermediate slits. The ventral edge still has the thickest cap of modified hypoderm. The vestibule has now expanded laterally into a wide space at the base of the branchiæ, and there are seven intermediate slits, the largest being dorsal and the smallest ventral in position. Advancing forward, or distally, the slits increase to nine, and the outer margin of the dilated ends becomes frilled as the filaments differentiate, the dorsal, where the largest slits are, soon presenting filaments connected only as their outer border, the free inner edge being deeply grooved (bifid in section) (Pl. II. fig. 12). The outer border of each filament has the tough cuticle with the hypoderm beneath, in which is a nerve, and joining in the centre a connective-tissue area which runs inward to the free grooved edge, whilst the sides are strengthened by the modified hypoderm, especially externally, for it tapers internally. Each of the laminæ forming the groove has a blood-vessel in its centre (Pl. III. figs. 18 & 19), and branches by-and-by enter the pinnules. Proceeding still further distally, the curve in each fan is larger, and the dorsal filaments, which have become rounder and their hypoderm more glandular, show longer connecting bands, and finally separate, the isolated ones having slightly shallower grooves than the fixed, whilst their radial diameter diminishes and their transverse increases proportionally.

The filaments gradually taper distally, the edges of the groove break into pinnæ (Pl. IV. fig. 25), and the modified hypoderm forms three distinct external divisions, whilst in the centre is the connective-tissue area with its blood-vessel, a vessel occurring also in each pinna. Besides the central blood-vessel there are two conspicuous channels slightly to the exterior on each side, and these probably communicate with the cœlom. In longitudinal sections of the filaments the centre shows a distinctly chordoid structure

not always easily observed, and this is apparently due to the cells of the hypoderm or to a supporting tissue within it, the former interpretation being the more likely, as no differentiation is observed in transverse section.

Diverse views have been held with regard to the structure of the filaments and pinnules; thus Meyer described a diverticulum of the cœlom in each filament and pinnule, whilst Orley insisted that only connective tissue occupied the centre. It is by no means easy to decide, since in the case of sections the parts are considerably altered even in good preparations. A cœlomic space occurs on both sides at the level of the dumbbell-shaped region in front of the brain (Pl. IV. figs. 20 & 21, *cœ.*), and their walls are defined by connective-tissue, and probably muscular, fibres, the area surrounding them consisting of nucleated connective-tissue cells. About this level the thoracic jacket or collar has just become free or is only connected by a narrow isthmus. As a rule, also, the two sides are asymmetrical in section, the opercular half having no slits, but a considerable cœlomic space, whilst the other side has only small apertures, so that the area within (that is, ventral to) the slits is reticulated, these reticulations in the succeeding sections becoming less and less until only the branchial vessel is evident. The epithelium surrounding the slits becomes regularly arranged and forms the hypoderm and cuticle of the filaments, each side being attached to a separate filament. The elongated centre of each filament in formation is almost wholly occupied by nucleated connective tissue with the blood-vessel in the centre, but two splits, one on each side of the mesentery, are often seen at the distal end of the central area, occasional strands of tissue crossing the spaces in some sections. The definite median mesentery with its central blood-vessel and the definite cœlomic spaces at each side, and from end to end in transverse section of a pinnule, as shown by Soulier in *Protula milhaci*, have not been observed either in filament or pinnule. In longitudinal sections of a filament, the sides are formed of cylindrical nucleated epithelium, whilst the centre is almost filled with nucleated connective-tissue cells, a narrow split at one or other side being present, and even this has a few strands with nuclei. The pinnules of this form (*Pomatocerus*) show only a central cavity in which the blood-vessel is (Pl. IV. fig. 24), but the cœlomic fluid could readily rush to and fro in the space around it, whether a special mesentery fixes it or not. On the whole, therefore, the view that the cœlomic spaces—carried forward to the splits for the commencing branchial filaments—do not blindly end there, but communicate with the filaments and

pinnules, would seem to correspond with the appearances. The branchial apparatus of such forms would thus in their movements appear to have not only muscular aid, but the important influence of the cœlomic fluid, so that the ciliary action of the pinnules and filaments would materially aid respiration as well as conduce to alimentation.

Opercular Stalk.—The opercular stalk arises as a process of the basal region of the branchial apparatus immediately in front of the brain, the tissues of one side gradually projecting (Pl. IV. fig. 20), then being nipped off as an independent process surrounded by the cuticle, the modified hypoderm as a considerable coat all round, and a central area more or less muscular at first, with numerous nuclei. The base of the organ occupies at first more than half the dorsal outline, but, as it separates and the median fissure deepens, the other side increases in bulk. The external fold of the cuticle bends inward, the hypodermic cells curving round the central area (Pl. IV. fig. 22) and soon the stalk is free. Its outline in section is somewhat rhomboidal, and much smaller than it is distally. At this level the thoracic jacket or collar is fixed by a broad isthmus to the region below the gullet. Then the stalk becomes conical in section, and the blood-vessel in the centre of the muscular tissue more distinct, whilst the modified hypoderm, which is almost fibroid in section, maintains nearly an equal thickness all round. The base of the cone—that is, the dorsal edge—by-and-by lengthens by a transverse projection at each side, so that it resembles a cocked hat in section (Pl. VI. fig. 32), the projecting edges having the thickest hypoderm from the approximation of the two layers separated by a line, the central pseudo-chordoid and muscular areas with the vessel remaining as before. The opercular stalk at this level is flattened externally or dorsally, convex ventrally, and its cuticle is dense. A differentiation of the central region now takes place, for the outer or dorsal edge of the hypoderm becomes thinner, and an elongate-ovoid and apparently muscular area stretches from lateral projection to lateral projection, a groove in which the blood vessel lies (Pl. V. fig. 30) occurring ventrally. The muscular fibres seem to pass to the calcareous region of the operculum—namely, to the tip of the stalk. They are well developed in the region of the lateral ridges. The appearance of the parts seems to vary considerably in sections of different examples, a feature due perhaps to recently reproduced organs (*cf.* Pl. VI. figs. 32 & 33) and to obliquity in section, for in some cases (Pl. VI. fig. 33) muscle and pseudo-chordoid tissue are both present. The reticulations of the next (more distal) area are larger and

better defined than the pseudo-chordoid tissue which occupies the convex region ventrally (Pl. VI. fig. 33). The chordoid axis soon increases in bulk, and fills the stalk except the thin hypodermic region and a stripe of pseudo-chordoid tissue, still with its blood-vessel ventrally, the cuticle enveloping all. The basement-tissue is slightly developed in the ventral arch, but forms a well-marked layer dorsally, fusing with the tough issue in the middle of the stalk, but being better differentiated at the base of each external ridge, a thin line of it running almost to the tip of the latter. The section of a nerve (Pl. VI. fig. 32, *n.*) occurs at each outer angle and in the middle of the dorsal arch, the former being outside the basement-tissue, the latter within it. In the basal (proximal) or incipient condition of the stalk this basement-tissue is less developed than distally, and the relationships of the nerve therefore undergo changes. The groove for the larger blood-vessel in some preparations sinks more deeply into the chordoid tissue. The projecting ends of the ovoid area of the opercular stalk assume a clavate outline and then disappear—that is to say, the ridge on each side of the stalk ceases after the lateral filaments of the stalk have separated. With the disappearance of the lateral ridges the chordoid tissue occupies in section the entire area of the ovoid stalk, only a thin, barely visible, belt of hypoderm occurring under the cuticle. In some of the sections the strands of the chordoid tissue are arranged in a somewhat radiate manner with the nuclei and cut ends of fibres at the circumference, so that, when the hypoderm and the cuticle are shed, such might be mistaken for the modified hypoderm. Further, the blood-vessel is now enveloped by the chordoid tissue. Soon a differentiation in the midst of this area appears as a smooth central region from which lines radiate to the external margin. This central region gradually increases distally, and the differentiation of the radiating cells with the nuclei externally gives it, in some preparations, the appearance of a hypoderm within a hypoderm as just mentioned; and, moreover, a ridge or papilla appears on one side of the actual cuticle or hypoderm. The blood-channel is enclosed in the inner area, and is large. The ventral hypoderm and cuticle diminish and disappear, leaving what was the chordoid area and its central region, with the addition of a small patch, isolated in cuticle, to represent the former envelope of the stalk, and that soon vanishes. Thus the enlarged opercular stalk now consists of the tough cuticle, the modified coating of the chordoid area representing the hypoderm, with its

nuclei externally and a large pale area, probably chordoid, with a well-defined ovoid outline, in the centre of which is the blood-vessel. Muscular fibres would thus act on the base and up the stalk of the operculum, whilst its rigid tissues distally are fitted to perform the part of a plug to the calcareous tube. Beyond the lateral subulate processes the distal region of the decalcified operculum presents externally a tough cuticular investment, then a layer of long hypodermic cells with the nuclei near the external border, the central area being occupied by a tough nucleated plasma with small spaces near the external margin, where a thin basement-tissue bounds the hypoderm.

In vertical section the decalcified operculum has on its convex side the thick cuticle very dense at the rim, then a deep layer of long narrow granular cells, a thin connective-tissue or chordoid centre, and on the concave surface (anterior) a narrow belt of reticulated tissue, and externally a cuticular coat about twice the thickness of that on the convex side. When viewed externally the distal (calcareous) region of the operculum presents a minutely reticulated condition all over (after decalcification).

It has generally been held that the operculum is developed on a modified branchial filament, and hence the occasional occurrence of one on each side, or the facility with which a new organ is produced on the right when the other is lost. Without calling this view in question, the foregoing account shows that about half the area of the body-wall behind the branchial base is concerned in the production of the operculum with its special differentiation of tissues, and that the development of the branchial filaments occurs in front under different conditions, and rather in association with the vestibule and mouth than with the protective, or it may be in certain cases the reproductive, functions of the operculum. The appearance of the inter-filamentar slits after the formation and separation of the opercular stalk point to a wide divergence both of structure and function, though it may be argued that these radical differences may have been evolved slowly in the history of the race. Yet eyespecks or more complex visual organs are never found on the opercula, while they are not infrequent on the branchial filaments; just as calcareous or other hard structures belong to the opercula, for the soft cellular thickenings of the tips of the branchial filaments, which characterize certain varieties of *Filograná*, and which some have supposed to perform opercular functions, can scarcely be placed in this category. Moreover, in some groups the opercula are very variable,

and may be present or absent, as in *Filograna*, with perplexing indifference, whilst in other forms their stability and characteristic shape have made them of specific importance. It is interesting in connection with the branchial view of the opercular stalk that transverse bars of bluish pigment are occasionally seen on it.

Muscular System.—Immediately behind the brain muscular bands pass from the sides of the ventral to the dorsal wall (or *vice versâ*), some of the same side being attached to the base of the opercular stalk dorsally—indeed, they seem to be strongest and best developed at first on that side. Ventrally they are inserted on each side of the nerve-cord, and by-and-by they bound the thoracic glandular organ on its inner border.

Behind the ganglia and the opercular stalk the body-wall assumes a more symmetrical outline, and the dorsal longitudinal muscles become more distinct and quite separate from each other, but the ventral longitudinal muscles are indistinguishable. In the median ventral region, however, a special thin longitudinal muscular band occurs on each side, and continues backward a short distance—disappearing as the actual ventral longitudinal muscles become distinct. These ventral longitudinal muscles are formed by fibres on the lateral region of the body-wall outside the anterior glandular organ and its appendix, and not in contact with the nerve-cords, which are separated from them by a considerable interval. Their outline in transverse section is elliptical, and, as the glandular organ in its progress backward diminishes, the fibres seem to pass externally; then, as the glandular tube disappears they form a thin stratum to the outer side of the nerve-trunks and in contact with them, the anterior median ventral fibres being still visible between the nerve-trunks. By-and-by the median, or pseudo-ventral, or anterior ventral, fibres (Pl. V. fig. 26, *m.*²) disappear from the middle line, and the ventral longitudinal form a spindle-shaped layer in section, separated by an interval from the dorsal, which bend inward at their lower ends, whereas the ventral pass outward below and beyond them. The dorsal and the ventral longitudinal muscles, however, by-and-by fall into line and the body-wall becomes more compact, the dorsal muscles retaining the great preponderance in bulk, and closely approximated to the ventral, only a slight incurvation of the inner surface and traces of the oblique muscle indicating the line of separation; yet the distinctly pennate arrangement of the fasciculi of the dorsal is characteristic. The nerve-cords are more

closely approximated than in front, but are still separated by a considerable interval. The body behind the foregoing region of the thorax becomes rounded in transverse section, a large area being occupied by the dorsal longitudinal muscles, which cover nearly two-thirds of the circumference (Pl. V. fig. 27), and form a broad belt in section, only slightly narrowed as it approaches the mid-dorsal line, where no distinct hiatus occurs, the whole forming a hoof-shaped belt. The ventral longitudinal muscles, on the other hand, form two spindle-shaped areas, now also with pennate fasciculi, separated by the median space containing the ventral blood-vessel. This disproportion of the dorsal longitudinal muscles continues to the posterior end, though in relation to the diminished area of the body-wall both sets of muscles are more bulky; whilst the thinning of the dorsal muscles toward the middle line is scarcely evident.

The dorsal longitudinal muscles, though comparatively small, are formed in front of the cephalic ganglia, and at the ganglia they show two lateral enlargements connected by a median band of fibres to which the dorsal vessel is attached. Behind the ganglia the connecting band of fibres is shorter (in transverse section), whilst the lateral enlargements are gradually increasing. These muscles do not at this part reach the lateral regions of the body, but lie in a special cavity invested by membrane on each side of the median dorsal vessel, the direction of the lateral masses being nearly vertical, since to their exterior is the dilated anterior end of the thoracic glands. Proceeding backward, the first change noticeable is an increase of the nucleated connective tissue in the median belt and its continuation between it and the enlarged lateral regions until each of the latter is separated, so that it lies in a membranous chamber of its own, the spindle-shaped median belt being characterized by its numerous connective-tissue nuclei. Moreover, the direction of the muscular fibres of this median band seem to differ, since they are obliquely cut in the sections. Each dorsal longitudinal lies in its sheath in this region, with the vertical bands of muscle and the dilated cavity of the thoracic gland to its exterior, the long diameter of the mass being still nearly vertical. Then, instead of being spindle-shaped, the median band of muscle is divided into two by a central dimple to which the mesentery from the dorsal vessel is attached. This separation of the two halves increases until there is a clear space between them, the median mesentery now being fixed to the basement-tissue inside the hypoderm, the separated portions of the muscles lying closely over

the larger masses beneath them, and they soon fuse with them, meanwhile this wide space dorsally intervening. The diminution of the cavity of the thoracic gland on each side permits the muscles to assume a more oblique position, so that their axis in section is directed downward and outward. On the disappearance of the thoracic glands (in the progress backward) the muscles more closely approach each other in the mid-dorsal line, the upper as well as the lower ends being pointed in section. Then a tendency for the lower ends to bend inward is noticeable, the investing mesentery being still visible externally, whilst the muscles have likewise considerably increased in bulk. This divided condition of the dorsal longitudinal muscles characterizes the anterior region of the body, for toward the middle there is complete union of the halves (Pl. V. fig. 27), and the entire muscle has greatly increased in size, forming a broad crescent which reaches by its expanded inferior edges almost to the ventral surface. No distinct trace of a mid-dorsal fissure is seen, the median mesentery being attached to a slight muscular ridge at its inner surface.

Alimentary Canal.—The various ciliated grooves from the branchial apparatus to the mouth converge to the double isthmus connecting the two fans, and which in the sections is usually V-shaped, the apex being directed ventrally (Pl. IV. fig. 23), the upper layer being pierced by a blood-vessel at each end. Then, proceeding backward, the V expands into a curve, the ventral isthmus receives a coating of hypoderm, both isthmuses becoming shorter and thicker, with a slit at either end opening by-and-by to the dorsal surface. Further, the cellular walls of the central chamber of the isthmus (the vestibule) have a more finely granular structure than the hypoderm covering the ventral surface, and the dorsal border is soon modified, by a median furrow, into two thick ridges—about the level of the origin of the stalk of the operculum. The dorsal wall of the vestibule or mouth increases in thickness, and the opercular stalk sends out a process which fuses with the opposite side, so that two apertures now exist, viz., the mouth and that dorsad of the groove and ridges and formed by the external pit. Processes fuse with the point of junction, and others from the dorsal region of the now irregularly quadrangular part soon fill up the extended area (Pl. IV. fig. 21), leaving a small space dorsad of the mouth with its ventral edge marked by the groove before-mentioned, and showing a slight differentiation of its hypodermic wall. The vestibule, on the other hand, has glandular walls which stain deeply

all round. This dorsal pit, still retaining the dorsal groove with modified cells on each side, then disappears, but it comes near the central nervous system, and perhaps performs a sensory function. Immediately thereafter the central nervous system occupies the region above the gullet—separated therefrom by strands of connective tissue with several apertures. The gullet has an internal lining of columnar nucleated cells which stain deeply, surrounded by a circular muscular coat and an external investment of reticulated tissue and nucleated cells. It is slung by several bands to the coelomic wall around it, and instead of its cavity, now diminished, having its long axis transversely placed, it is vertical. Below it is the commissure between the œsophageal ganglia, above it is a large transverse space in which the dorsal vessel by-and-by appears, and the common duct of the thoracic glands occurs below the hypoderm above it, and blood-vessels lie internally. The investing cells and tissue increase in bulk, and the cut ends of numerous vessels are intermingled, whilst median furrows give a cruciform aspect to the central cavity in section, and longitudinal muscular fibres are more distinct within the circular coat. Below it is the ventral blood-vessel in the median line. The nuclei of the coelomic cells are distinct and correspond with those investing the alimentary canal. In this region (thoracic) the dorsal and ventral blood-vessels are of large size, and the rete around the alimentary canal well developed as a ring of longitudinal vessels in section (Pl. VI. fig. 35). The alimentary canal now increases in size, and, in the preparations, shows a tendency to split into layers, the entire lumen being filled up by the various coats. Instead of the firm circular coat with a few longitudinal fibres between it and the columnar epithelial layer characteristic of the smaller œsophagus, the area in section enlarges, the circular coat becomes thinner, the longitudinal investment within it thickens, as also does the cellular mucous layer, and there is a tendency to separation of these coats in the sections—indeed, it is clear that a change is taking place in the structure of the walls of the gut, probably representing a differentiated stomach, the central part in the sections representing the invaginated gullet and the larger separated external region the stomachal wall. The latter consists internally of a closely arranged, almost fibroid, cylindrical epithelium of uniform thickness, then of the longitudinal fibres, followed by the thin circular coat. The foregoing coats are invested by the cellular and a vascular coat, which presents two variations, for the smaller region in front shows the cut ends

of numerous longitudinal blood-vessels and a large dorsal vessel, whereas the larger stomachal area, with its firm and thick walls and its central vertical slit, has externally a blood-sinus all round, and no separate dorsal vessel is now apparent. The narrower anterior region, therefore, with its numerous longitudinal vessels, may differ in function from the wider posterior region surrounded by a blood-sinus.

The enlarged region, with its thick walls, continues beyond the posterior termination of the thoracic glands—that is, after the formation of the ventral longitudinal muscles—and behind this where the body-wall is wider and more flattened. Food is more frequently present in the anterior part than in the wider posterior region. In the narrower part of the body, behind the foregoing, where the muscles become proportionally massive, the walls of the intestine are much folded and the area is large, but the structure of the wall is the same, though little cellular tissue surrounds the vascular sinus externally. Still further back the gut dilates into a wide chamber without folds and having the vascular sinus externally. Then it thickens laterally, apparently from a septum-like fold with a vertical **V**-shaped slit in the centre, the upper and lower arches being thin. Thereafter the firm and rather thick-walled canal shows a median pair of plates in section, as if from a fold or valve (Pl. V. fig. 31), and then, proceeding backward, enlarges so as to form the two halves of a pear which fill up the entire central area, a slit soon appearing in the middle of each half, and finally broadening out into a **T**-shaped fold, which runs from the transverse dorsal folds by a long median one to the ventral wall (Pl. V. fig. 27, *d.*). Such appears to be a valvular structure, and it is interesting that the lateral walls are thin, the ventral arch thick, and the dorsal somewhat thin in the median line, whilst the double stalk of the **T** is thick. The double stalk of the **T**, indeed, widens, has the structure of the gut, even to the vessels, on its walls, and gradually takes the place of the wall in front, for it is apparently a valvular invagination. If the serial sections can be relied on, it would seem that in this region the sinus breaks up into longitudinal vessels, the ventral remaining as before. The gut is of various shades of brown or reddish brown, the glands of its walls usually being brown by transmitted light.

Toward the tail (Pl. VI. fig. 34) the chief feature is the diminution of the canal and the larger size of the cells of the cylindrical epithelium, which is richly ciliated, lining it. The wall of the gut is sometimes folded, but no distinct

evidence of a typhlosole in this region occurs. Moreover, whilst the ventral vessel remains in position, the vascular branches on the walls are inconspicuous, though they seem to form a reticulate series. This part of the gut is often loaded with sandy débris, surrounded by the dilated but tough investment of the gut-wall, which appears to contain inner longitudinal and circular muscular fibres, though these are only visible in some sections, the tough investment in dilatation being apparently homogeneous, as observed in cases where the cylindrical epithelium has disappeared by maceration.

Nervous System.—The cephalic ganglia occur behind the bases of the branchiæ, their anterior border appearing about the level of the base of the opercular stalk as it begins to project from the somewhat quadrangular outline of the body in section. They form a fused mass above the œsophagus, supported in front by a dense group of nucleated cells with slight differentiations at each side, probably indicating the issue of nerves. Then a somewhat narrow band appears, chiefly of transverse fibres with two large nerves passing off at each end, one entering the base of the operculum on the left and the other entering the lateral tissues, whilst those on the right go to corresponding parts. The central part of the ganglia behind increases in bulk, the organ forming a broad band with an enlargement at each end, the whole surrounded by a coating of the nucleated cells, and many transverse commissural nerve-fibres appearing in the centre. The outer enlargement then bends downward and elongates ventrally, the transverse commissural fibres still persisting between the sides, but finally these are gradually replaced by the nucleated cells, and the great nerve-cords, widely separated, lie on each side of the œsophagus. Before this occurs, however, long commissural fibres pass between the trunks over the œsophagus. There is thus a variation from the ordinary arrangement in typical forms, in which these cords slant below the œsophagus and meet more or less closely in the first ganglion of the chain. The nerve-cords are wide apart in the region of the muciparous glands, and it is just after these have been passed in the backward progress that a small neural canal is observed at the inner end of each trunk—still at a considerable distance from its fellow, and with the fibres of the special interneural bands of longitudinal muscular fibres still present. The nerve-trunks lie at the inner edge of each ventral longitudinal muscle, which forms a comparatively thin plate on

each side. In the middle of the body the nerve-cords are still separated by a considerable interval, the median mesentery with the ventral vessel being attached to the basement-tissue between them, and each has a large neural canal filled with coagulable substance superiorly—occupying fully half the area. Instead of the more or less complete fusion of the ganglia at intervals, all that occurs in this type is a slight increase of the nerve-cells in the separate trunks and the passage of commissural fibres between them, with an increase of the neuroglia and its nuclei, the large neural canals undergoing no change. The interganglionic regions are recognized by the absence of the transverse or commissural fibres and of the increased neuroglia, and by the conspicuous condition of the median ventral mesentery with its blood-vessel, the strands of the mesentery passing directly to the basement-tissue.

Posteriorly the great nerve-cords are nearer each other, yet separated by a considerable interval. In section they have the same granular and streaked appearance, with a small neural canal at the upper and outer border, which lies against the inner margin of the ventral muscle. Numerous neuroglial nuclei occur at the commissural regions, which occur as in front. In longitudinal sections of the tail the nerve-cords follow every fold of the body-wall, dipping with a sharp angle into each pit, so that the neural canals have no noteworthy influence in this connection. The main direction of the nerve-fibres is longitudinal, and lateral branches leave at each dissepiment even to the tip of the tail.

Various authors have dealt with the general topography of the nervous system of the Serpulids: the earlier, such as De Quatrefages, described a smaller and a larger pair of cephalic ganglia which lie over the œsophagus, with the various nerves which proceed from them. Pruvot also held that there were two pairs of ganglia. E. Meyer, again, found that in *Psygmobranchus protensus* and *Eupomatus lunuliferus*, Clap., there were, in addition to the smaller central and the larger lateral lobes from which the great trunks to the branchial system arise, two accessory lobes to the latter; and his minute account of the branches from the cephalic ganglia and of those from the great nerve-cords (termed by him "spinal nerves") is excellent and his figures carefully drawn.

Reproduction.—In the ripe female, longitudinal sections of the tip of the tail show that the larger ova in the cœlomic spaces do not, as a rule, extend quite to the tip, about eight

segments presenting only small ova. As the sections pass downward from the dorsum toward the ventral aspect a process appears at the posterior edge of the rounded projection formed by each segment. This is the first indication of the segmental organ, and, in accordance with the structure of the parts, it appears earliest in the terminal segments, the process surrounding the cavity of the segmental organ. These processes, as well as the hypoderm of the segment, are outside the basement-membrane, which, with the circular fibres, separates them from the longitudinal muscles in the preparations. In transverse sections of the caudal region it is seen that these segmental cavities pass inward and downward, to open by a wide aperture on the ventral surface (Pl. VI. fig. 34, *ao.*) on each side of the ventral groove, and the ripe ova can be followed from their inner (cœlomic) aperture to the wide external one. These wide tubes might aptly be called, after Dr. Goodrich, cœlomoducts, since they transmit only the reproductive elements, which enter at the space above and to the exterior of the outer ends of the ventral longitudinal muscles. Besides the conspicuous larger ripe ova, smaller ova occasionally occurred in the canal. These segmental organs seem to be simple wide passages for transmitting the ova to the exterior without the complexity of structure observed in other forms. The inner opening is above and to the outside of the ventral longitudinal muscles, the canal curving round the latter to open on the ventral surface below it. The ovaries are situated over the ventral longitudinal muscles, the products being shed into the cœlom, in which further growth takes place. The females, from November onward for some months, have a bright pinkish coloration posteriorly, so that the breeding-season is prolonged.

In passing from behind forward the size of the body-wall and its muscles increases, but the general arrangement of the segmental organs and of the ovarian tufts is the same, the external apertures being outside the shallow ventral groove of the region and of the nerve-cord on each side.

So far as could be observed, no atrophy in the wall of the alimentary canal takes place in the ripe forms, and the muscles of the body-wall likewise are normal.

The Serpulids proper, in the separation of the sexes, are in contrast with such as *Spirorbis* and *Amphicora* (a Sabellid), in which Meyer observes that the anterior abdominal segments are female, the posterior male; whereas in *Salma-cina* Giard held that this condition is reversed.

EXPLANATION OF THE PLATES *.

PLATE I.

- Fig. 1.* Transverse section through the region of the cephalic ganglia, *cg.*, of a large *Bispira voluticornis*, Montagu. The chordoid skeleton, *ch.*, is at this level divided into lateral halves, whereas a little in front it forms a continuous arch from side to side. *cm.*, ganglionic commissure; *d.*, œsophagus; *cd.*, dorsal processes; *ct.*, thoracic collar or jacket; *m.*, anterior single mass of longitudinal muscles; *tgo.*, median or common duct of thoracic glands. Enlarged.
- Fig. 2.* Similar section anterior to the former, the chordoid arch being now complete. *bv.*, branchial blood-vessel, which is dividing into branches; *ch.*, chordoid skeleton; *vc.*, ventral region of the collar; *n.*, nerve. Enlarged.
- Fig. 3.* Transverse section of the cephalic region of a young example (partly macerated) at the origin of the branchial filaments indicating the tentacles, *t.* From its macerated condition the margins and posterior region are only diagrammatic. Slightly reduced from Zeiss oc. 4, obj. A.
- Fig. 4.* Transverse section of the distal region of a macerated branchial filament. \times oc. 4, obj. A.
- Fig. 5.* Longitudinal section of a branchial filament in a similar condition, to show the arrangement of the chordoid skeleton. \times oc. 2, obj. D.
- Fig. 6.* Longitudinal section of another filament, indicating the appearance of the cellular hypoderm covering the chordoid skeleton. Young example. \times oc. 4, obj. D, with 2 inches of draw-tube.
- Fig. 7.* Transverse section of a tentacle, with its peculiarly curved lamellæ and its central skeleton and vessel.

PLATE II.

- Fig. 8.* Transverse section of the anterior region of *Bispira voluticornis*, Mont. The dorsal muscles are proportionally small and somewhat rounded, the bristles are still at the dorsal edge, and the ventral longitudinal muscles are somewhat pointed externally, though little weight is to be placed on this feature. A complex series of muscular fibres passes from the dorsal longitudinal muscles downward to the inner border of the nerve-area, and above the point of meeting is the ventral blood-vessel, *vv.* s., blood-sinus around the œsophagus. Enlarged.
- Fig. 9.* Transverse section a little behind the former. The dorsal and ventral longitudinal muscles are larger, whilst the absence of the sheets of muscle passing from the dorsal to the ventral aspect permits the oblique muscles, *om.*, to be seen passing to the edge of the nerve-cords. The commissure between the ganglia is marked, the ventral vessel being above it. The hypoderm in the mid-ventral line remains massive. Enlarged.
- Fig. 10.* Portion of the chordoid skeleton. The passage of processes

* I am indebted to the Carnegie Trust for the artists' aid with these Plates.

from the external mass, *pr.*, throughout the reticulated central region and their fusion with the inner edge are indicated. *m.*, muscle. $\times 650$ diam.

- Fig. 11.* Transverse section of the anterior region of *Bispira*. *d.*, oesophagus surrounded by firm muscular bands; *tg.*, thoracic glands with pale membranous tubes of chloragogenous tissue, *chl.*, attached; *nc.*, great nerve-cords. \times oc. 4, obj. A.
- Fig. 12.* Transverse section of two branchial filaments with their chordoid axes before separation. \times oc. 4, obj. D.
- Fig. 13.* Transverse section of a ventral longitudinal muscle in the posterior region of the annelid, with portions of a segmental organ, *so.* \times oc. 4, obj. A.

PLATE III.

- Fig. 14.* Transverse section of the ganglionic region of *Bispira voluticornis*, showing the eyes, *oc.* *cp.*, last trace of the external cephalic pit; *vf.*, ventral fimbriae. \times oc. 4, obj. A.
- Fig. 15.* Transverse section of the ganglionic region with the great nerve-cords, *nc.*, at the sides of the oesophagus and about the level of the chordoid skeleton, *ch.*, the external margin of which is not smooth, but has processes. Cells and fibres intervene between the dorsal muscles, *dm.*, and strong transverse fibres below them, whilst under these are vertical fibres, more or less mesenterial, in which the common duct of the thoracic glands, *tgo.*, lie. The massive ventral hypoderm, *hp.*, occurs inferiorly. The dorsal region is only partially represented, and the lower division of the great muscular mass is only indicated at *m.* The preparation is somewhat stretched inferiorly. Enlarged.
- Fig. 16.* Transverse section toward the termination of the thoracic glands, *tg.*, which are represented by two tubes. *om.*, connective tissue with nuclei and muscular fibres, probably part of the oblique muscle of the side. \times oc. 4, obj. A.
- Fig. 17.* Transverse section of the region of the nerve-cords in the middle of the body. *hp.*, hypoderm; *nc.*, nerve-cords; *vv.*, ventral blood-vessel with a coating of chloragogenous cells, *chl.* \times oc. 4, obj. A.
- Fig. 18.* Slightly oblique section of a branchial filament of *Pomatocerus triqueter*. *bv.*, blood-vessel; *ca.*, coelomic space; *n.*, nerve. \times oc. 2, obj. D.
- Fig. 19.* Transverse section of a branchial filament toward the base and where its inner edge is produced into a groove with ciliated sides. \times oc. 2, obj. D.

PLATE IV.

- Fig. 20.* Transverse section of the anterior region of *Pomatocerus triqueter*, L., near the origin of the opercular stalk (*op.*). *d.*, the vestibule; *ds.*, dorsal pit; *hpi.*, modified hypoderm covering the inner surface of the thoracic collar or jacket and the outer side of the body-wall. The dorsal surface is to the right. \times about 35 diam.
- Fig. 21.* Transverse section of the body-wall in front of the foregoing. The opercular stalk (*op.*) projects much further, the dorsal pit (*ds.*) is larger, and the slits (*df.*) indicating the spaces between the branchial filaments are present. Spaces (*ca.*), apparently coelomic, occur on each side. \times about 35 diam.

- Fig. 22.* Transverse section of the region in front of *fig. 21*, in which the opercular stalk is separating and the slits (*bf.*) for the formation of the branchial filaments making rapid progress on the other side. On the ventral surface (left in the figure) the thoracic collar is free. Similarly magnified.
- Fig. 23.* Transverse section after the separation of the opercular stalk and when slits are appearing on the left or opercular side (upper in the figure). The great expanse of the vestibule, *d.*, is noteworthy; *n.*, branchial nerve, the others lie toward the inner ends of the slits. Only the inner branchial nerve, *n.*, is indicated in this figure.
- Fig. 24.* Transverse section of the tip of a branchial filament of the foregoing. The blood-vessel occupies the centre. It is richly ciliated in life. \times oc. 2, obj. D.
- Fig. 25.* Longitudinal section of a filament of *Pomatocerus triqueter*, L., with portions of pinnules. \times oc. 2, obj. D.

PLATE V.

- Fig. 26.* Transverse section of the anterior region of *Pomatocerus triqueter*, L., with the thoracic glands, *tg.*, in full development, that on the left showing the origin of the duct which joins that of the opposite side at the median outlet (*tgo.* in Pl. III. fig. 15 for *Bispira*). *cm.*, cellular appendix of the thoracic gland; *d.*, oesophagus with its chloragogenous coat; *dm.*, dorsal longitudinal muscles; *hyp.*, modified hypoderm; *m.*¹, special anterior median muscular layer on the dorsum; *m.*², special ventral layer of muscle; *nc.*, nerve-cords. Above the gullet is the dorsal blood-vessel in the median mesentery, and a space occurs above it between folds of mesentery, but soon disappears. \times about 35 diam.
- Fig. 27.* Transverse section of the body-wall toward the posterior region. The dorsal muscles, *dm.*, are of great size, with scarcely a trace of separation in the mid-dorsal line; *vm.*, ventral muscles; *vv.*, ventral vessel with chloragogenous cells externally. The outline of the gut is T-shaped. \times about 35 diam.
- Fig. 28.* Transverse section of an anterior foot with the hook-pad about the level of the diminishing thoracic gland, *tg.*; *ab.*, incipient muscular fibres of the process opposite the external papilla, *p.* In this section none of the peculiar clavate nucleated cells are visible. \times oc. 2, obj. A.
- Fig. 29.* Section behind the foregoing cutting the superficial part of the hook-pad, and showing the greatly developed hypodermic cells with the nuclei situated externally, and forming an elastic cushion in connection with the dense row of minute hooks, *tg.*, thoracic gland. \times oc. 2, obj. A.
- Fig. 30.* Transverse section of the opercular stalk in another example, in which the central area is chordoid or areolar in aspect. The nerves are not entered. \times oc. 4, obj. A.
- Fig. 31.* Transverse section of the alimentary canal, showing lateral folds of the mucous membrane, almost valvular in appearance. \times 350 diam.

PLATE VI.

- Fig. 32.* Transverse section of the opercular stalk (now shaped like a cocked hat) after the lateral ridges have appeared. The great development of the modified hypoderm (*hpi.*) is conspicuous. *n.*, nerves; *bt.*, basement-tissue, which is highly developed. \times oc. 4, obj. A.
- Fig. 33.* Oblique section of the distal end of the operculum, showing on the right the presence of the ridge and on the left a reticulated aspect of the region beyond after decalcification. \times oc. 2, obj. A.
- Fig. 34.* Oblique section of the tip of the tail of a mature female specimen. *ov.*, ova; *vm.*, ventral longitudinal muscles; *ao.*, external aperture of the modified segmental organ; *d.*, anus. The canal is richly ciliated in this region. \times oc. 2, obj. A.
- Fig. 35.* Transverse section of the oesophageal region, with its thick mucous lining internally, its chloragogenous coat (*chl.*) externally, with its plexus of blood-vessels (*bv.*). *dv.*, dorsal blood-vessel. \times 280 diam.

II.—*New Forms of Dendromus, Dipodillus, and Gerbillus.*
By OLDFIELD THOMAS.

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Dendromus (Poemys) exoneratus, sp. n.

Closely allied to *D. nigrifrons* of East Africa and Uganda, but larger and with whitish ear-patches.

General colour as in *nigrifrons*, but the blackish frontal patch and the dorsal line less developed. At the anterior base of the ears, just in front of the base of the proectote, there is a pair of whitish patches, each about 3 mm. in diameter, which throw up by contrast the blackish frontal patch. These whitish patches are found in all the six specimens from Nigeria available, and in none of those from Uganda and British East Africa.

Skull decidedly larger than that of *nigrifrons*.

Dimensions of the type (measured in flesh by collector):—

Head and body 61 mm.; tail 71; hind foot 18; ear 13.

Skull: greatest length 21.3; condylo-incisive length 19; zygomatic breadth 10.5; interorbital breadth 3; breadth of brain-case 9.7; palatal length 8.7; upper molar series 3.2.

Hab. Panyam, Bauchi Province, Northern Nigeria. Alt. 4000'.

Type. Adult female. B.M. no. 12. 1. 16. 19. Original number 83. Collected 16th September, 1911, and presented by the Rev. G. T. Fox. Six specimens.

Distinguished from its ally *D. nigrifrons*—near zoologically, but very distant geographically—by its longer skull, the whitish pre-aural patches, and the reduced black markings.

Dipodillus jordani, sp. n.

A very small gerbil, apparently representing in Algeria the little *D. mariae* and *D. henleyi* of Lower Egypt.

Size less than in *D. simoni*, greater than in *mariae* and *henleyi*. General colour dull sandy, very much as in the first-named, the dorsal hairs prominently tipped with dark brown, so that the general tone is much darker and duller than the bright clear buffy of *D. henleyi*. Supraorbital light patches not very white, but extended backwards nearly to the ear, where they almost join the snowy white post-auricular patches. Ears small, their edges brownish. Soles naked, with the usual six pads. Tail longer than the head and body, greyish white below, pale brownish above and at the end, which is inconspicuously pencilled, its hairs about 5 mm. in length.

Skull with the broad brain-case and small muzzle characteristic of *simoni*, *henleyi*, and other allied species. In size it is markedly less than in *simoni*, larger than in *mariae* and *henleyi*. Supraorbital edges with fine sharp and slightly overhanging ledges, about as in *D. henleyi*. Bullæ large, exceeding those of the larger *D. simoni*, about equalling those of *D. henleyi*. Molars small.

Dimensions of the type (measured in the flesh):—

Head and body 67 mm.; tail 80; hind foot 19·5; ear 9.

Skull: greatest length 22·4; greatest diagonal length to back of bullæ 22·3; condylo-incisive length 20·2; nasals 7·7; breadth of brain-case 11·6; palatal foramina 3·8; diagonal horizontal diameter of bulla 8·5; upper molar series 3·0.

Hab. (of type). Guelt-es-Stel, Central Plateau of Algeria. Alt. 900 m.

Type. Old male. B.M. no. 12. 6. 12. 100. Original number 111. Collected 22nd April, 1912, by Dr. K. Jordan. Presented by Lord Rothschild.

I have hitherto hesitated to describe this little gerbil on

account of its general resemblance to *D. simoni*, Lataste, from near the same region. But I now see that its longer tail, smaller skull, smaller teeth, and proportionally larger bullæ indicate that it is not really related to that animal, but is an Algerian ally of the Lower Egyptian *D. maricæ*, Bonh., and *D. henleyi*, de Wint., from both of which it differs by its larger size. I have named it in honour of its captor, Dr. Jordan, of Tring, to whose efforts in collecting Algerian small mammals the National Museum is so largely indebted.

Dipodillus arabium, sp. n.

Allied to *D. famulus*, but with less heavily tufted tail and even larger bullæ. Sides not completely naked.

Size rather smaller than in *famulus*. General colour of the same soft drabby fawn, darker on the back, paler and clearer on the sides. Top of nose with scarcely a trace of a dark nose-patch. White patches over eyes and behind ears well marked. Ears rather short, their proectote coloured like the head, not darkened. Hands and feet white as usual. Soles essentially naked, but there are a number (twenty to thirty) of small hairs on the terminal third, upon and between the pads, thus showing an approximation to the condition in *Gerbillus*; pads six in number, the proximal ones small. Tail rather shorter than in *famulus*, well-haired and tufted as compared with most members of the group, but with nothing like the remarkable tuft found in *famulus*; whitish below and on the sides, its upper surface mixed brown and fawn, the terminal tuft brown, but perhaps like that of *famulus* black when unbleached.

Skull with narrow interorbital region, low and broad brain-case, and bullæ even larger, though very slightly so, than in *D. famulus*.

Dimensions of type (measured in flesh):—

Head and body 86 mm.; tail 140; hind foot 24; ear 13·5.

Skull: greatest median length 28·7; greatest diagonal length 29·5; condylo-incisive length 25·6; zygomatic breadth 15; nasals 10·8; interorbital breadth 5·2; breadth on lip of meatus 15·8; palatal foramina 4·6; greatest diagonal horizontal diameter of bullæ 11·2; upper molar series 3·7.

Hab. Tebuk, on the Hedjaz Railway, Arabia. Alt. 2000'.

Type. Adult male. B.M. no. 10. 3. 12. 1. Original number 7. Collected 3rd January, 1909, by Douglas Carruthers. Two specimens.

This pretty species seems only nearly related to the *D. famulus* of Aden, the other species of this region all having comparatively small bullæ. Its partially hairy soles seem peculiar to itself and to the species next described.

On the same expedition Mr. Carruthers also collected, at a place about 200 miles east of the Dead Sea, an example almost topotypical of, and certainly referable to, *D. dasyuroides*, Nehring*. But I fail to see any reason for its distinction from *D. dasyurus*, Wagn., from the neighbouring coast of the Red Sea, of which we have two examples from Sinai, presented by the Giza Zoological Gardens. Nehring himself gives no valid reasons for the distinction, merely saying that the species "appears to be new, although allied to *D. dasyurus*, which is so insufficiently described that nothing can be done without examination of the type." Both *dasyurus* and *dasyuroides* have bullæ of the comparatively small size usual in the genus.

Dipodillus hilda, sp. n.

A Moroccan species with partially hairy soles.

Size and general appearance very much as in the browner forms of *D. campestris*, to which the type has been hitherto referred. General colour above russet- or cinnamon-brown, not unlike the deepest and richest specimens of *Apodemus sylvaticus*. Sides clearer and lighter, approaching "sayal-brown." Under surface, as usual, pure white. Face with scarcely perceptible supraorbital light patches; post-auricular white patches present. Ears with their proectote prominently blackish, contrasting markedly with the general colour of the head; hairs on metentote white. Hands and feet white. Soles with six pads, the region between the second and posterior pairs thinly clothed with fine hairs, very much as in *D. arabium*. Tail buffy brown above, darkening terminally, whitish below; the tip probably not heavily tufted, but this part is imperfect in the type.

Skull considerably smaller and narrower than that of *D. campestris*, apparently like that of *D. arabium*, but the bullæ have been lost in the type.

Measurements of the type:—

Tail (imperfect) more than 100 mm.; hind foot (wet) 22.5; ear 15.

Skull: greatest length 28; zygomatic breadth 15; nasals

* SB. Ges. Nat. Berl. 1901, p. 173.

11·2; interorbital breadth 5·2; breadth of brain-case 13·5; palatilar length 12·5; palatal foramina 5·1; upper molar series 3·5.

Hab. Northern Morocco. Type from the sea-coast 70 miles (122 kilometres) south-west of Tangiers.

Type. Old female. B.M. no. 86.9.10.1. Collected and presented by Capt. Savile Reid.

The specimen on which this species is founded has lain for 30 years among the series of *D. campestris*, to which it has a strong superficial resemblance. But examination of its feet and skull shows that it has really nothing to do with that animal, but represents in Morocco the same type of gerbil as that just described as *D. arabium*; it is therefore a form entirely new to the fauna of Barbary.

Dr. Cabrera has noted that there is a gap in the distribution of *D. campestris* just in the region where Capt. Savile Reid captured this gerbil.

Gerbillus calidus, sp. n.

A pale desert-coloured species allied to *G. paeba*.

Size about as in *paeba*. General colour above pale sandy fawn, not or scarcely darkened on the back. Under surface wholly snowy white, the white rather high up on the sides, and wholly enclosing the fore limbs, on to which the darker body-colour does not encroach. Area round eyes whitish, not sharply defined; a small white patch behind ears. Ears pale fawn, like the head, their edges not darkened. Feet wholly white; soles hairy throughout except for a round patch on the heels, and at the bases of the digits just distal to the large compound sole-pad. Tail whitish, the upper surface a little darker; the slight terminal crest browner.

Skull more slender than that of *G. paeba*, the bullæ smaller.

Dimensions of the type (measured in flesh):—

Head and body 85 mm.; tail 99; hind foot 24; ear 17.

Skull: greatest length 28·3; condylo-incisive length 24·8; zygomatic breadth 14; nasals 11·2; interorbital breadth 5; breadth of brain-case 13·3; palatal foramina 5·3; diagonal horizontal diameter of bulla 8·2; upper molar series 4·0.

An older specimen has a tail 115 mm.; hind foot 25·5; greatest length of skull 30; bulla 8·8.

Hab. (of type). Molopo, W. of Morokwen, Bechuana-land. Other examples from Otjimbingue, Damara-land (*Andersson*).

Type. Young adult male. B.M. no. 4.10.1.72. Original

number 76. Collected 11th July, 1904, by R. B. Woosnam. Five specimens examined.

This is the species quoted as *Gerbillus pæba schinzi*, Noack, by Schwann *, who rightly identified it with Andersson's Damara specimens so named by me some years before. But in making that earlier determination I was clearly in error, as Noack's animal was much larger, had naked metatarsals, and was probably some form of *Taterona*.

From *G. pæba* this gerbil is readily distinguishable by its much paler colour, the complete inclusion of the fore-limbs in the white body area, and its smaller bullæ.

Gerbillus pæba broomi, subsp. n.

Paler than true *pæba*, the foot longer.

Colour dark sandy fawn, intermediate between that of *G. calidus* and of true *pæba*; the hairs of the back pinkish buff, heavily darkened by their brown or blackish tips; the sides clearer pinkish buff. Under surface as usual white, but this does not pass across the fore limbs, as on the front of these the body-colour runs down to the wrists. Face rather greyer than body. Postorbital and postauricular light patches present, but inconspicuous. Ears greyish with a narrow brown edging. Hands and feet white; soles hairy to the same extent as described above in *calidus*.

Dimensions of the type (measured in the skin):—

Head and body 100 mm.; tail 109; hind foot (wet) 28·5.

Hab. Port Nolloth, Namaqualand.

Type. B.M. no. 98.9.3.2. Collected September 1897 and presented to the National Museum by Dr. R. Broom.

A paler form of Smith's *G. pæba*. There is in the Museum collection an example of this group from Deelfontein, Central Cape Colony, so closely matching Smith's type (which was said to come from north of Latakoo) that I am disposed to think some mistake was made by Smith as to the region where his type was got. For north of Latakoo would have been in the desert area, where the desert form *G. calidus* occurs, while the type of *pæba* (which is also that of *tenuis*) is of strong non-desert cinnamon-colour, very like the Deelfontein specimen. Possibly it was obtained on the way out or home, as Smith passed, and that then it was wrongly supposed to have been got at his farthest north.

* P.Z.S. 1906, i. p. 106.

III.—*New Species of Indo-Malayan Heterocera, and Descriptions of Genitalia, with reference to the Geographical Distribution of Species resembling each other.* By Colonel C. SWINHOE, M.A., F.L.S., &c.

[Plates VII.—XI.]

THE geological distribution of species has always been the weak point of all lepidopterists; the superficial resemblance of specimens from widely different parts of the globe has sufficed to declare them as of identically the same species. I have endeavoured in this paper to show that this is easily disproved by the examination of the genitalia. When the genitalia are so different as to make it impossible for breeding with each other, it is positive proof of the difference of species. Classification based upon eye-judgment alone is bound to be faulty. There are, of course, many problems before us still: species which appear to the eye abundantly distinct have a habit of presenting similar genitalia; on the other hand, species which to the eye appear to be identical possess genitalia which are very distinct from each other.

I am much indebted to the Rev. C. R. N. Burrows for the great pains he has taken in dissecting the moths I have sent him, and to Mr. F. N. Pierce of Liverpool, to whom all Mr. Burrows's drawings were submitted by him, and to them both for their joint report. All the Plates were drawn by Mr. Burrows and the text-figures by Mr. Pierce, and the remarks on the genitalia of the different species are extracts from their joint reports.

Family *Agrotidæ*.

Chloridea marmada, nov.

♂. Palpi, head, thorax, and fore wing whitish flesh-colour, nearly white, without any markings whatever except black dots on the vein and on the outer margin of the wing; hind wing pure white, with a black outer marginal band, cilia white. Underside: both wings white, fore wing with a discoidal black spot and a short medial subterminal black band, hind wing with a similar black band; abdomen with the basal segments white above, the two middle segments red-brown, the anal segments shading paler; anal tuft with pale

red-brown hairs. On the underside the body and legs are white.

Expanse of wings, ♂, $1\frac{2}{10}$ inch.

Hab. Roebourne, Australia.

The shape of the wings is similar to that of *C. obsoleta*, Fabr., but the fore wing is narrower.

Euxoa cabara, nov.

♀. Head, thorax, and fore wing ochreous brown: fore wing with the costa yellowish, with black and pale yellow spots; a black spot in the cell and another at the end; sub-basal, antemedial, medial, and postmedial outwardly curved transverse lines of black dots, the first two more or less obsolete hindwards, the last outwardly edged by a pale yellowish line; between this and the margin there is a pale brown band composed of a double line of spots, the margin with black lunules; cilia brownish yellow, with basal black minute lunules, a yellowish line between the two rows of lunules: abdomen and hind wing pale brown, the cilia yellow, with minute black lunules. Underside: fore wing with black and yellow dots on the costa towards the apex; a double discal row of brown spots, the outer row with a black spot on the costa; the whole inner surface of the wing from these rows to the base of the wing is brown, the outer portion whitish grey: hind wing whitish grey, irrorated with brown atoms; a black discoidal spot, an outwardly curved brown macular band in continuation of the inner macular row of the fore wing; cilia of both wings whitish grey, with black basal points.

Expanse of wings, ♀, $1\frac{2}{10}$ inch.

Hab. Padang, W. Sumatra; three specimens.

Family Acronyctidæ.

Genus AMPHIPYRA, Ochs.

I have long been in doubt that *A. surnia*, Felder, from Japan, was the same as *A. pyramidea*, Linn., from Europe; and, moreover, I have always been of opinion that there were two species in Japan, and therefore sent examples of both to Mr. Burrows, and also an example of *A. magna*, Walker, from the Punjab, and his and Mr. Pierce's joint report, com-

paring their genitalia with that of the European species *A. pyramidea* from Mucking in Essex, is as follows:—

“These mounts show four distinct species closely allied.

“Plate no. IX. fig. 12. *urnia* (Yokohama, Japan) (mounted dorsal uppermost). Valve squared, uncus large, cornuti long and fine, no pips on ‘vessica.’

“ „ „ 13 *a. pyramidea* (England). Valve pointed upwards, many hairy cornuti, many pips.

“ „ „ 14. *magna* (Punjab). Valve pointed but not upturned, enormous cornuti, pips large and few.

“ „ „ 15. *yama* (Asama Yama, Japan). Valve square, the uncus agrees with the other forms but much smaller, there are a large number of cornuti.”

Amphipyra yama, nov.

♂ ♀. Palpi, head, and body ochreous brown; collar and thorax pricked with grey and white: fore wing with a short longitudinal black streak inside the end of the cell; subbasal line indicated by a black mark on the costa; antemedial line consisting of obscure black lunules pricked with white; a postmedial sinuous line of black lunules outwardly edged with white; some black streaks on the veins between this and the outer margin, which contains black lunules at the vein-ends inwardly edged with white; cilia ochreous brown: hind wing pale dull red, without markings. Underside: both wings brownish grey; a pale, outwardly curved, brownish discal band, and on the hind wing a discoidal spot; face, pectus, thorax, and legs dark greyish brown; tarsi black.

Expanse of wings $2\frac{2}{10}$ inches.

Hab. Asama Yama, Japan.

Allied to *A. urnia*, Felder; fore wing narrower, and the apex subacute; genitalia different (Pl. IX. fig. 13).

Family *Erastridae*.

Lophoruza cretonia, nov.

♂ ♀. Head and body ochreous brown; wings dull ochreous, irrorated with brown, markings red-brown: fore wing with the costa brown, with some darker spots; faint transverse

somewhat sinuous lines, subbasal and antemedial, the outer third of the wing brown, paling towards the costa; a large yellowish-white patch near the hinder angle, consisting of three conjoined spots, decreasing in size from the hinder margin upwards, the patch with broad dark brown sides containing small pale dots on the margins: hind wing darker in colour, with a central yellowish space.

Expanse of wings 1 inch.

Hab. Coomoo, Sherlock River, Australia.

Cerynea sumatrana, nov.

♂. Head and body dark chocolate-brown; thorax with a yellow spot on each side; abdomen with yellow bands, most prominent on the first two segments: wings with the basal half ochreous, thickly irrorated with brown on the basal two-thirds, the outer portion of the ochreous space with the minute irrorations leaving an ochreous band across the middle of the wings, not reaching the costa on the fore wing, its outer edge outwardly angled above the middle and below the middle on the hind wing; the costal space and outer marginal space dark chocolate-brown; the outer margin of both wings with black spots; cilia dull ochreous, with brown spots and brown tips. Underside: fore wing blackish brown, an ochreous spot at the end of the cell, hinder margin with the basal half ochreous; hind wing blackish brown, an ochreous middle band and a black spot in the cell.

Expanse of wings $\frac{9}{10}$ inch.

Hab. Padang, W. Sumatra.

Family *Stictopteridæ*.

Stictoptera talagi, nom. nov.

Stictoptera tongluana, Swinhoe, Ann. & Mag. Nat. Hist. (8) xix. p. 338 (1917).

Hab. Talagi (*Everett*).

I made a mistake in reading the label on this species. Talagi is a small island off Isabel Island in the Solomon group; Tonglu is in Sikkim. It is therefore necessary to alter the name of the species.

Family *Sarrothripidæ*.

Characoma sumatrana, nov.

♂. Resembles *Characoma curiosa* *, Swinhoe, from Burma.

* Trans. Ent. Soc. 1890, p. 235.

Head, body, and fore wing grey, irrorated with minute chocolate-brown atoms; markings chocolate-brown; a band behind the head: fore wing with a duplex, outwardly and evenly curved band across the wing at the basal third (*curiosa* also has this band, but it is sharply angled inwards below its middle); some brown marks at the base, costa and hinder margin of the wing, a patch on the costa extending from near the band to near the apex; a fine medial, waved, transverse line, which does not reach the hinder margin; a small ringlet in the interno-median interspace beyond the middle, some spots in a row above it; a sinuous subterminal line; a double marginal line with its upper half filled in with brown; cilia grey, with some pale brown marks: hind wing white, with some slight grey suffusion on the outer margin.

Expanse of wings, ♂, $1\frac{8}{10}$ inch.

Hab. Padang, W. Sumatra.

Blenina alena, nov.

♂ ♀. Head, thorax, and fore wing uniform dark grey; a brown line behind the head and a brown line down each side of the thorax; abdomen pale grey: fore wing irrorated with minute brown atoms; subbasal line represented by a black spot on the costa and another below it; antemedial line very sinuous, commencing with a spot on the costa, then outwardly curved, bent inwards at the cell, then outwards into a long acute angle, and runs down to the hinder margin; post-medial line also very sinuous and more or less dentate in parts, outwardly highly curved, some marginal black points and pale grey cilia: hind wing greyish white, the costal and outer marginal spaces suffused with brownish grey, the veins dark grey on the outer half of the wing. Underside: fore wing blackish brown, a small space at the base and the hinder margin white: hind wing much as it is on the upper-side.

Expanse of wings, ♂ ♀, $1\frac{3}{10}$ inch.

Hab. Mackay, Queensland.

Selepa orangea, nov.

♀. Palpi, head, body, and fore wing blackish brown; the ground-colour of the fore wing is really pale pinkish, but it is most thickly covered with blackish irrorations, leaving a pale streak below the costa and a broader pale streak from the costa near the apex to the middle of the hinder margin; reniform and orbicular represented by white dots, the latter

surrounded by blackish and again by pale pinkish; a duplex, oblique, and highly curved line, centred with white from the median vein near the base to the middle of the wing above the hinder margin; above this is a similar circular duplex line outside the space round the orbicular, these lines more or less indistinct; an obscure pale pinkish space on the hinder margin beyond the middle; marginal line black, inwardly edged with pale pinkish on both sides; cilia brown: hind wing dark grey, the outer margin brownish; outer marginal line black, somewhat sinuous, outwardly edged with a pale line; cilia brown.

Expanse of wings, ♀, 1 inch.

Hab. Sarawak, Borneo.

Gadirtha guineana, nov.

♂ ♀. Palpi greyish white, second joint black on the sides; head and thorax mixed grey and white; a black stripe behind the collar and one on each side of the thorax; abdomen dark grey, with darker segmental bands: fore wing with the ground-colour white, densely irrorated with pale chocolate-brown; costa with a large black antemedial patch and a smaller curved subapical patch, and two black spots between them; orbicular and reniform round black rings, pale inside and dull ochreous spot in their centres, the former small, the latter very large; black marks below the first patch, some black spots in an oblique row in the disc, black marginal lunules at the vein-ends, and a number of black spots close together on the outer half of the hinder margin, above which there is some whitish suffusion: hind wing pale grey, outer margin broadly blackish; cilia of both wings pinkish grey.

Expanse of wings, ♂ ♀, $2\frac{1}{10}$ – $2\frac{2}{10}$ inches.

Hab. Dinawa, 4000', Mt. Kebea, 6000', New Guinea (*A. E. Pratt*).

Several examples. Some of the specimens have a dark central suffusion, somewhat resembling *G. impingens*, Walker; genitalia different (Pl. IX. figs. 10 & 11); note the difference in the valvule, costa, uncus, and the extraordinary development of the gnathos, which is new to us; the tegumen is also utterly different.

Family **Acontiidæ**.

Genus MAURILIA, Möschler.

M. iconica, Walker, is quite different from *M. cervina*,

Walker—two cornuti in the latter, three in the former, one short and two gementate, besides other differences shown in the figures. *M. undaira*, mihi, and *M. tunicata*, mihi, are also distinct species; besides the enlargement of the costa, the cornuti are absent, the rugose patch on the vesica is much more prominent, and there are many other features which the figures will show (note arm on costa and cornuti). I have *undaira* from New Guinea and *tunicata* from New York, N. Queensland, and had specimens from both localities examined (Pl. VII. figs. 1, 2, 3, 3 α , & 4).

Maurilia instabilis.

Anomis instabilis, Butler, Ill. Het. B.M. vii. p. 72, pl. cxxxi. fig. 3 (1889).

Maurilia iconica, Hampson (part.), Phal. xi. p. 373 (1912).

The prominent black discoidal lunule on the fore wing differentiates it from *iconica*; the genitalia is also somewhat different; note the thickening of patch on costa and the two cornuti instead of three.

In my collection from Kursejong and the Khasia Hills.

Pl. VII. fig. 1 *instabilis*, fig. 2 *iconica*.

Maurilia tunicata, nov.

♂. Palpi brown, first joint white beneath; head, thorax, and fore wing of the type-specimen pale rufous tinged with ochreous; in the other examples the colour is darker, markings indistinct, but apparently similar to those of *M. undaira*; hind wing pale black, veins dark black; abdominal area somewhat paler. Underside blackish, the costa and hinder margin of the fore wing and the costa and abdominal margin of the hind wing whitish; pectus, body, and legs white, legs with brown stripes; tarsi black, with white rings.

Expanse of wings, ♂, $1\frac{3}{10}$ inch.

Hab. Cape York, N. Queensland, Australia; two examples.

Pl. VII. fig. 3. Note the difference of arm on costa and cornuti.

Maurilia undaira, nov.

♂. Palpi, head, body, and fore wing purplish brown; two antemedial lines, a large round whitish reniform, with a minute yellow centre ringed with brown, this large spot interrupting the medial line, all erect and sinuous, the sub-basal line not distinguishable; two oblique, sinuous, post-

medial lines from the costa beyond the middle to the hinder margin near the angle; a submarginal sinuous series of black points, all these lines somewhat indistinct: hind wing blackish brown, becoming pale towards the abdominal margin; no markings; cilia of both wings concolorous with the wings. Underside rather pale purplish black: fore wing with centre suffused with black, the hinder marginal space whitish grey, and the costa grey: hind wing with some (but less) black suffusion in the middle; a discoidal black lunule; the abdominal marginal space pale: body and legs of the colour of the wings, legs with white stripes, tarsi with white rings.

♀. Paler, with a rufous tinge; markings similar.

Expanse of wings, ♂ $1\frac{3}{10}$, ♀ $1\frac{6}{10}$ inch.

Hab. Ekeikei, 1600', New Guinea.

Genitalia distinct, note arm on costa, no cornuti (Pl. VII. figs. 3 a & 4).

Maurilia fortis, nov.

♀. Palpi, head, thorax, and fore wing dark rufous, with a curved dark brown patch below the middle of the costa, containing a dull scarlet patch against the costa and a curved similarly coloured spot on its lower outward side; a white dot ringed with brown in its centre, two grey large spots or patches inside the outer part of the brown space, and a white dot; lines a little darker than the ground-colour; subbasal lines short; two oblique sinuous antemedial lines, two similar postmedial lines, a submarginal series of black dots; cilia brown, with white tips: hind wing pale brown, costal space grey, no markings; cilia ochreous, with white tips. Underside: body white; legs white, with a brown stripe on the upper side; tarsi dark brown, with white rings: wings grey, fore wing with some brownish suffusion in the cell region; cilia of both wings brown.

Expanse of wings, ♀, $1\frac{7}{10}$ inch.

Hab. Ekeikei, 1500', New Guinea.

Maurilia dalama, nov.

♀. Palpi pale red, the last joint brownish; thorax dark pinkish brown; collar and fore wing pinkish red; abdomen pinkish grey, with brown segmental lines: fore wing uniform pinkish red, lines slightly darker; indistinct subbasal line short, antemedial line slightly sinuous, erect; a faint lunular

discoidal mark, a short sinuous mark above it, another sinuous line inwardly below it; a postmedial highly curved and recurved line; a row of submarginal black dots; cilia concolorous with the wing: hind wing white, without markings. Underside: body, legs, and wings white, somewhat shining, without any markings.

Expanse of wings, ♀, $1\frac{2}{10}$ inch.

Hab. Queensland, Australia.

Carea intermedia, nov.

♂. Head and thorax dark flesh-pink; a dark line down each side; abdomen white, with some flesh-pink suffusion and segmental lines: fore wing clear, pale flesh-pink; a darker line from the costal third to a little beyond the middle of the hinder margin, nearly straight, slightly bent inwards below the costa; a dark inwardly and evenly curved line from the costa one-fourth from the apex to the hinder angle, some slight darker shading on the upper half; on the inner side of this line a faint line runs close to it; outer marginal line and cilia dark brown: hind wing pure white, without markings; cilia brown.

♀. More pink than the male; the fore wing is very uniform in shade of colour, with very faint traces of the transverse lines.

Expanse of wings, ♂ ♀, $1\frac{4}{10}$ inch.

Hab. Kandy, Ceylon, and Palni Hills, S. India.

The lines are disposed like those in *C. subtilis*, but it is altogether a different-looking insect. I have *subtilis* of both sexes from different parts of India and also from Ceylon.

Pl. VIII. fig. 6 *subtilis*, fig. 7 *intermedia*; the genitalia varies but little.

Carea innocens, nov.

♀. Palpi, head, thorax, and fore wing bright pinkish red; palpi white beneath, the colour of the wing very uniform and bright; the only lines at all distinguishable are two, and these are very indistinct—the first a slightly curved line a little darker than the ground-colour from the costa before the middle to the hinder margin near the angle, the other an erect whitish line from the costa one-fifth from the apex to the hinder angle; the cilia is brown, the outer margin of the wing angled as in *C. subtilis*: hind wing white, the outer margin narrowly suffused with pale pinkish red; cilia similarly coloured, with pale basal line: abdomen white, with

dorsal black dots. Underside: both wings pale pinkish red, hinder marginal space of fore wing glistening white, the base and abdominal half of hind wing whitish; body and legs white; upperside of legs pinkish red.

Expanse of wings, ♀, $1\frac{1}{2}$ inch.

Hab. Palhi Hills, Bandora, near Bombay.

Acontia dohertyi, nov.

♀. Palpi yellow, its upperside dark brown; head, thorax, and fore wing bright clear yellow, very uniform in colour: fore wing with the markings dark chocolate-brown, costal line chocolate-brown, subbasal line hardly visible, antemedial line inwardly curved obliquely from the costa, one-third from the apex, then inwardly curved to the hinder margin one-third from the hinder angle, forming a very acute angle above its middle, its point continued to the outer margin below the apex; a curved line from the costa before the apex to the end of the other line below the apex; postmedial line similar in shape, its point with a line connecting it with the antemedial line at its middle; a spot at the upper end of the cell, a fine anteciliary line, and dark chocolate-brown cilia: hind wing yellowish white, without markings; cilia pale chocolate-brown. Underside: both wings yellowish white, without markings.

Expanse of wings $1\frac{4}{10}$ inch.

Hab. Sambawa Island, west of Java (*Doherty*).

Acontia talauta, nov.

♂. Palpi, head, thorax, and fore wing dark chrome-yellow: fore wing with the lines rufous, antemedial line very acutely outwardly angled to a point on the median vein, then inwardly oblique to the hinder margin at the basal third; postmedial line similarly shaped, commencing on the costa near the apex and ending on the hinder margin a little beyond the middle; a slightly curved short line from the costa one-fourth from the apex, almost parallel with the upper part of the postmedial line; a black dot close to the apex of the wing, the outer marginal space broadly suffused with dark red-brown, its inner side irregular and highly curved; much as in *A. transversa*, Guen.; outer margin of the wing with a line of yellow lunules, cilia dark brown: hind wing yellowish white, nearly white, no markings, marginal line yellow and sinuous, cilia brown. Underside pale yellowish grey, the hinder marginal space of the fore wing and inner portion of

the hind wing paler; pectus dark brown, body and legs greyish brown.

Expanse of wings, ♂, $1\frac{7}{10}$ inch.

Hab. Talaut Island, south of the Philippines (*Doherty*).

The genitalia is somewhat similar to that of *A. migrator*, Walker, from Australia (type from Moreton Bay, Queensland, in B.M.). I have it from Rockhampton, Queensland, but the colour of the insect is very different. *A. migrator* is quite distinct from *A. transversa*, Guen., from India, of which Hampson makes it a synonym.

Pl. VIII. fig. 8 *talauta*, fig. 9 *migrator*.

Family Catocalidæ.

Enmonodia padanga, nov.

♂. Purple-brown tinged with pink, head and collar dark brown; thorax purplish grey with a brown stripe down each side; abdomen with the basal half grey with brown segmental bands, the anal half crimson with brown segmental lines: fore wing with the costal and basal spaces and a smear in the disk purplish grey, the rest of the wing dark purplish brown; a dark brown stripe from the apex to vein 5; an angulated black line down the disk to the hinder margin, outwardly lined with purple-grey (somewhat obscure); a sub-terminal row of black lunules; an inverted comma-shaped discoidal mark composed of fine black rings, its inner end with an oval black spot attached to its outer side: hind wing uniform purple-brown, a postmedian pinkish-grey transverse line composed of conjoined acute angles. Underside uniformly ochreous-scarlet: fore wing with the costa brown; a large round brown spot in the middle of the cell, two brown bars closing the end; three angulated thick brown outwardly-curved lines close together across the middle; a broad brown transverse band on a pale brown space in the outer marginal space: hind wing with a brown lunule in the cell; the three centre thick lines as in the fore wing, but more widely separated from each other, the marginal space as in the fore wing.

♀. Brownish ochreous, minutely irrorated with brown atoms; two round black spots encircled with brownish ochreous opposite the end of the cell; a straight double thin dark brown band from the apex, broadening hindwards and extending to near the abdominal margin of the hind wing, the marginal space outside these lines thickly smeared with

brown; a subterminal series of acutely angled white conjoined marks on both wings from the double line hindwards; on the hind wing between the medial band and the white angular series is a brownish shaded band, the outer margin of the wing dark brown. Underside with the ground-colour as in the male, but densely irrorated throughout with brown atoms, two brown bars closing the cell of the fore wing; a medial blackish-brown line across both wings, bent inwards on to the costa on the fore wing; a similarly shaped but angulated post-medial line, a double submarginal line, the inner one thickened towards the costa of fore wing, and a thin row of black lunules close to the margin; cilia of both wings black.

Expanse of wings, ♂ 3, ♀ $3\frac{1}{2}$ inches.

Hab. Padang, Sumatra.

Anua clementi, nov.

♀. Head, thorax, and fore wing clear ochreous grey: fore wing not irrorated as in most of the species of this group, but striated with grey over the entire wing, the fine striations quite clear throughout and more numerous towards the outer margin; a hardly visible ear-shaped mark at the end of the cell, an angulated black spot on the costa beyond the middle, from its point an outwardly curved, waved, faint grey line runs to near the middle of the hinder margin, where it is bluntly angled and runs up to the costa one-fourth from the base; a broad brown diffused band down the wing one-fifth from the outer margin, angled outwards below the costa, where it is darkest, then somewhat acutely angled inwards and again outwards; cilia brown: hind wing bright ochreous yellow, a broad black discal band, not reaching the hinder angle and suddenly narrowing before reaching the costa near the apex. Underside greyish ochreous: fore wing with a very large lower discal black patch: hind wing with a pale discal brown band, blackish on the costa, and enlarged and black at its lower extremity, which does not reach the hinder angle.

Expanse of wings, ♀, 3 inches.

Hab. Roebourne, Sherlock River, Australia (*Clement*).

The black band of the hind wing in the type-specimen is much broader than in the others. I have three examples, all females; I can find no striations on the fore wing of any of the long series in my collection of this group. I have seven species, there is no black spot, angulated or otherwise, in the centre of any of them.

Ercheia anvira, nov.

♂. Head, body, and fore wing pinkish brown: fore wing with a pale brown stripe below the middle running from base to outer margin; transverse lines brown, subbasal; short antemedial and medial; the postmedial line bends outwards from the costa in a circle, is bent abruptly inwards below and then straight to the hinder margin; all these lines are sinuous and double; a brown subapical patch in the costa, reniform, ear-shaped, pale, and on a small brown patch; terminal line crenulate; cilia pale with brown tips: hind wing black, greyish towards the base and abdominal margin; a white spot at the end of the cell, one close to the hinder angle, one near the outer margin below the middle; an elongated white spot on the margin below the apex and another above the hinder angle. Underside pale greyish yellow: fore wing with the costa brown; a brown stripe below the middle from the base to the postmedial brown band, which is straight; a broad discal band: hind wing with a small round spot at the end of the cell; a highly sinuous thin median band, a broad irregular-shaped discal band; both wings with small black lunules on the outer margin.

Expanse of wings, ♂ $1\frac{6}{10}$, ♀ 2 inches.

Hab. Kina Balu, Borneo.

Seven males.

Ercheia careona, nov.

♂ ♀. Head, collar, and thorax pinkish grey; thorax with a brown patch in the middle: fore wing dark pinkish black, pinkish-grey irrorations towards the base; the hinder margin broadly pinkish grey, irrorated with pinkish-brown atoms, this feature less strongly defined in some of the females; a submarginal pinkish-grey line and some pinkish-grey irrorations on the margin: hind wing black, paling somewhat towards the base and abdominal margin; a large white spot at the end of the cell, connected with another near the hinder margin; a long white mark on the outer margin below the apex, and another behind the hinder angle. Underside much as in *anvira*, but the bands are broader.

Expanse of wings, ♂ $1\frac{1}{2}$, ♀ $1\frac{9}{10}$ inch.

Hab. Kalao Island, near Celebes.

One male and five females.

Ercheia enganica, nov.

♂ ♀. Head and body greyish brown: fore wing with the ground-colour brownish pink, irrorated with brown; a triangular black basal patch, edged with white, its lower side limited by vein 1, containing three ochreous costal dots and a subbasal ochreous basal line, the outer lower portion of the wing more densely irrorated; a short white line on the discocellulars, a white dot above it, another outwardly below it; a thick black lunular spot, outwardly pale-edged, in the middle of the first interspace, another beyond it with a black sinuous line, outwardly edged with white, connecting it with the hinder margin; a large black patch on the costa extending to the apex, a white submarginal line running through it and continued with an outward curve to the hinder margin; an indistinct series of black lunules on the margin; cilia brown: hind wing black, slightly paling towards the base; a large white spot at the end of the cell, a smaller one near the middle of the outer margin, and a still smaller one near the hinder angle; a long white streak on the outer margin below the apex. Underside pale yellowish on basal half, then black to the outer margin; a broad white postmedial band narrowing hindwards, a white patch at the apex and halfway down the margin: hind wing with a black spot at the end of the cell; an antemedial outwardly curved thin black band, followed by a white band; the outer half of the wing black, with a thin white band running through it; a white streak on the margin below the apex; a spot on the middle and another near the hinder angle.

Expanse of wings, ♂ $1\frac{1}{2}$, ♀ 2 inches.

Hab. Engano Island, near Sumatra.

Two males and one female.

Genus *BASTILLA*, nov.

Belongs to Hampson's first section of his genus *Parallelia*; mid-tibiæ of male dilated, with a groove containing a fringe of large scales; hind tarsi of male with the first joint fringed with hair above at base; fore wing with the costa lobed before middle.

Type, *Bastilla redunca*, Swinhoe, Cat. Het. Mus. Oxon. ii. p. 141 (fig.) (1900).

Dysgonia manillana, nov.

♂ ♀. Head and thorax greenish brown; abdomen greenish

grey with thin segmental brown lines: fore wing with the basal third greenish brown, blackish towards the antemedial line, where it gradually becomes nearly pure black and is outwardly edged with white; a broad white medial band minutely irrorated with grey; a black discal band, its inner side suffused and thickly joined along the costa to the antemedial line, its outer side angled outwards below the costa and again at its middle, then curving and narrowing inwards to the hinder margin and edged with white; the outer portion of the wing pale brown with a darker shade running through it, ending in an apical black patch with its inner side suffused, its outer side dentated, some dark suffusion at the outer margin: hind wing with the basal third pale brown, a medial white band, darker brown outside it, some white suffusion at the middle of the outer margin; a thin brown marginal line on both wings; cilia of fore wing pale brown, of hind wing white with some pale brown on its lower part. Under-side brownish grey; a broad, diffused, discal, brownish band on both wings with the outer margin whitish.

Expanse of wings, ♂, $1\frac{3}{10}$ inch.

Hab. Manilla, Philippines.

Dysgonia fruhstorferi, nov.

♂. Head and body grey-brown: fore wing with the basal third grey-brown; a broad medial white band rather thickly irrorated with minute grey atoms, especially on the upper and lower ends, the band evenly inwardly curved on both sides, edged with black on the inner side and with a large triangular black patch on the outer side, its outer edge from the costa a little apart from its inner edge, curved into an acute point, then slightly curved inwards and narrowing to a point on the hinder margin, slightly edged with white from the costa to the point, four white costal dots between it and the apex, a brown shade from the apex running down the outer side of the black patch followed by a whitish shade, the outer margin brownish and two black angular spots at the apex, the upper one encircled with white, the lower one edged with white at its outer side; small black marginal spots and cilia; altogether more or less of the *stuposa* pattern: hind wing grey-brown, faint indications of a thin greyish band down the middle and greyish on the middle of the outer margin.

Expanse of wings, ♂, $2\frac{1}{10}$ inches.

Hab. Fergusson Island, Papua (*Fruhstorfer*).

Chalciope saina, nov.

♂. Antennæ and palpi grey-brown, the latter black at the sides; face and pectus greyish ochreous, the latter with a black stripe on each side; legs ochreous grey marked with black; head, body, and wings ochreous brown: fore wing with the inner portion filled in by a very large black elongated triangular patch, edged with whitish, its upper and lower sides almost straight, its outer edge slightly evenly inwardly curved, leaving the margins narrow, its upper point very acute and nearer the apex than it is even in *C. cephise* of Cramer; an oblique narrow white band through its middle, open at both ends, the ends slightly irrorated with brown, some black points on the outer white lining of the black patch, the outer margin brown; the cilia brown with a pale inner line; some whitish suffusion on the hinder margin: hind wing dark brown; a faint, narrow, grey band not nearly reaching either the costa or the hinder angle, where there is a little pale suffusion; cilia grey.

Expanse of wings, ♂, $2\frac{2}{10}$ inches.

Hab. Nias.

Allied to nothing I know of; the largest species of the genus I have yet seen.

Hypætra minima, nov.

♀. Palpi dark brown at the sides, whitish beneath, the tips of last joints white; head, body, and fore wing uniform chocolate-brown: fore wing with a deep black subbasal quadrate patch with pale edgings close to the hinder margin, excavated on its upper and lower sides, a brownish patch between it and the costa; a curious hook-shaped deep black mark at the end of the cell, its upper part thickened and quadrate, a brownish patch between it and the costa, another brownish patch on the costa before the apex, and a small one at the apex; a series of minute black dots on the outer margin: hind wing chocolate-grey, a little paler basally, no markings; cilia of fore wing pale chocolate-brown, of the hind wing slightly paler than the wing-colour, two whitish subapical spots on it and another at the hinder angle. Underside: fore wing greyish brown, hinder margin white, cilia grey: hind wing pale greyish brown, the outer margin broadly darker, cilia white, greyish at the tips.

Expanse of wings, ♀, $1\frac{3}{10}$ inch.

Hab. Luzon, Philippines.

Family Erebiidæ.

We cannot believe that the genus *Argiva* and its allies can belong to the family Catocalidæ. It seems to us that *Argiva* has no relation whatever to the genus *Catocala*; their structure is completely different; they have enormous black densely hairy extensile organs ("coremata") upon the dorsal surface of the tegumen, almost hiding the armature of the delicate valves. These alone confirm, by the absence of the large scaptulum of *Catocala*, that the relationship is mistaken. Pl. X. fig. 20 shows the genitalia of *Argiva hieroglyphica* (the type of *Argiva*), fig. 21 that of *iraxini*, Linn. (the type of *Catocala*), copied from Pierce's 'Genitalia of British Noctuidæ,' fig. 23 that of the common European species, *nupta*, Linn.; note the entire absence of the coremata and the asymmetry of *nupta*, which is usual in *Catocala* and its relatives.

The habits of life of such of the species as are known to me are entirely different to those of the Catocalidæ; they are crepuscular and mostly cave-dwellers, very quick and sharp in their short flights, the males darting forwards and attacking those that pass, much after the manner of some of the butterflies of the family Nymphalidæ. This is particularly the case with *Patula macrops*; I have watched them in the caves of the Island of Elephanta in the Bombay Harbour.

Genus ARGIVA, Hübner.

The genitalia of the different forms of *Argiva* are very similar; the differences are so slight, they may arise from mounting. I give the figure of the costa of *A. hieroglyphica*, the type of the genus (text-fig. 15). There appears to be no difference in any of the mounts except the "costa," which varies slightly under different names.

Argiva lunaris.

Bocana lunaris ♀, Walker, xxxi. 57 (1864).

Nyctipas hieroglyphica, Hampson (part.), Phal. xii. p. 275 (1913).

Hab. Celebes, Gilolo.

A perfectly distinct species, sexes alike. I have both sexes from N. Celebes and Gilolo (text-fig. 18).

Argiva sumbana, nov.

♂. Much like the male of *lunaris*, but the subapical yellowish-white bar is not continuous, but is shorter even than in *hieroglyphica* and is broken into two pieces. Underside paler; two large subapical spots, well separated, another in the middle of the disk.

♀. Fore wing with the basal two-thirds ochreous brown, the outer third black-brown, the comma-shaped discoidal mark as in the male; the subapical bar white and short,

Fig. 15.



Fig. 16.



Fig. 17.



Fig. 18.



Fig. 19



Fig. 15.—*hieroglyphica*. "Costa" more parallel sides.

Fig. 16.—*sumbana*. "Costa" perhaps running narrower.

Fig. 17.—*luzonica*. "Costa" perhaps more curved.

Fig. 18.—*lunaris*. "Costa" appears narrower, but hardly in the same plane.

Fig. 19.—*ceramica*. "Costa" somewhat differently shaped.

consisting of three attached spots, the two lower ones large, the upper ones small; no other markings; hind wing similarly coloured, and with a large white upper discal spot. Underside paler and more ochreous, the spots ochreous white; the subapical spots as above, but not connected; a discal row of large spots across both wings; the middle spot in the fore wing and the second upper spot in the hind wing pushed outwards.

Expanse of wings, ♂ 3, ♀ $3\frac{4}{10}$ inches.

Hab. Sumba Island (*Doherty*) (text-fig. 16).

Argiva luzonica, nov.

♂. Brown-black, the inverted comma-shaped discoidal mark very indistinct, without any distinguishing blue or white scales; the subapical streak very narrow, little more than a thick sinuous line, the colour dark chrome-yellow: hind wing unmarked. Underside paler, the subapical streak thicker and ochreous white, separated into two pieces; a faint small ochreous-white spot in the middle of the disk; hinder marginal spot suffused greyish.

Expanse of wings, ♂, 3 inches.

Hab. Luzon, Philippines (text-fig. 17).

Argiva ceramica, nov.

♂. Black-brown, the inverted comma-shaped discoidal mark very obscure, hardly traceable; the subapical streak more curved than in the other forms, slightly thickened on the costa, but otherwise of fairly even width, ending in a point quite close to the outer margin; colour ochreous white; no other markings. Underside paler, the subapical streak similar; the hinder marginal space of the fore wing slightly suffused with grey.

♀. Fore wing with the basal two-thirds ochreous brown, the ring of the discoidal mark the only distinct part of this mark, its tail well separated from its beginning and connected with a highly curved black line to the hinder margin; the outer third of the wing dark brown; the subapical streak broad, narrowing hindwards, its end blunt and not reaching the outer margin; a large white spot in the middle of the disk: hind wing with the basal half dark brown, the outer half ochreous brown, divided by a series of indistinct whitish marks. Underside paler; both wings uniformly coloured, except that the hinder margin of the fore wing is slightly greyish; the subapical streak and discal spot as above; a minute whitish spot in the upper disk of the hind wing.

Expanse of wings, ♂ 3, ♀ $3\frac{1}{2}$ inches (text-fig. 19).

Hab. Ceram Island.

Genus *CARIONA*, nov.

Differs from the genus *Patula* in having the hind wing normal, the neuration normal. In *Patula* the costal half is aborted, and forms a fold turned over on the upper surface containing a large glandular patch, making the veins aborted. Section III. B. of Hampson's genus *Nycipao*, Phal. xii. p. 286 (1913).

Type, *albicincta*, Kallar.

Genus EREBUS.

Erebus variegata.

Nyctipao variegata, ♂, Butler, Ann. & Mag. Nat. Hist. (5) xiv. p. 432 (1887); Hampson (part.), Phal. xii. p. 296, pl. 206. fig. 6, ♂ (1913).

Hab. Solomons.

N. caliginosa, Butler, *l. c.* p. 433, which Hampson makes the female of *variegata*, is a distinct species; it is not the female of *variegata*. I have the true female of *variegata*, also from the Solomons (from Shortland Island); it is very similar to the male, has more white suffusion in the wings, and is much larger.

Erebus ephesphoris.

Phalæna noctua crepuscularis, Cram. Pap. Exot. ii. p. 99, pl. 160. fig. A (1779) (nec Linn.).

Nyctipao ephesphoris, Hübner, Verz. Schmett. 272, 2675 (1827).

Nyctipao ephesphoris, Walker, xiv. 1305 (1858).

Nyctipao leucotenä, Guen. Noct. iii. p. 184 (1852); Hampson, Phal. xii. p. 298, pl. 207. figs. 7 ♂, 8 ♀ (1913).

Hab. Amboina.

I have one male and three females from Amboina which are undoubtedly identical with *leucotenä* and with Hampson's excellent figures. The type came from Amboina.

Erebus sapaaræa, nov.

♀. Chocolate-brown, tinged with ochreous: fore wing with indications of a subbasal band; a rather broad sinuous antemedial brown band from costa to hinder margin, followed by a similar band a little before the middle, outwardly edged with greyish ochreous from the hinder margin to the whorl-shaped discoidal mark, which is very large; its black ring strongly outwardly edged with white, which thickens on the costa and has a billhook-shaped large centre filled in with brownish ochreous, ringed with deep black, and edged inwardly and outwardly with white; a brown thin even discal band with a slight outward curve from the costa to the outer margin, followed by a pale and more ochreous space; the other third of the wing as dark as its basal portion; a large subcostal white spot before the apex, oval and excavated on its outer side, a small white lunule immediately below it, followed by five white lunular marks inwardly edged with black down the disk—the first minute, the fourth well outwards, the row ending in an outwardly-curved white line close to the hinder margin; cilia brown with white spots at

the interspaces in the lower two-thirds of the wing: hind wing with two bands in continuation of the third and fourth bands of the fore wing, the pale ochreous-tinged space extending almost to the outer margin; a large oval subapical white spot and a row of six white lunules, three and three in echelon. Underside paler and more ochreous; a black and white discoidal lunule on each wing; the subapical and discal spots as above.

Expanse of wings, ♀, $4\frac{4}{10}$ inches.

Hab. Sapaaræa, Celebes.

Erebus niasana, nov.

♂. Chocolate-brown; head and thorax dark brown; abdomen brownish grey, the first two segments filled in with black-brown, nearly pure black, the next pale grey, the rest of the abdomen darker grey: fore wing with a thick white line, a thin band from the hinder margin one-fourth from the base obliquely towards the apex curling round the discoidal whorl-shaped mark, its outer side before it begins the curl broadly pale grey, extending in a subdued form to the apex of the wing, with some pure white patches outside the band; the ground-colour of the wing above this band very dark chocolate-brown; the black ring round the discoidal mark sinuous, the inner portion is black and confused, outwardly ringed with dull brownish ochreous; a large triangular white subapical spot; some indistinct blackish discal lunules, one or two of them pricked with white: hind wing with the pale grey band of the fore wing continued subbasally, followed by a thin dark brown band; a medial band, an ochreous-grey discal shade with black spear-shaped marks on its outer side; a subapical white lunule and an indistinct submarginal lunular line. Underside with the basal two-thirds pale and ochreous-tinged; fore wing with a subapical white spot and three in the disk; hind wing with a subapical small spot.

♀. Paler than the male; the medial pale grey band obscure; a whitish slightly sinuous line across the disk of the fore wing edged with brown, and continued across the middle of the hind wing; a large subapical spot on the fore wing, with five discal white lunules, outwardly edged with black, the third and fifth with the white only indicated on the hind wing; there is an antemedial band, a white subapical lunule, and a discal row of black lunules inwardly edged with white. Underside as in the male.

Expanse of wings, ♂ $3\frac{8}{10}$, ♀ $4\frac{2}{10}$ inches.

Hab. Sitoli, Nias.

Erebus malanga, nov.

♂. Head and thorax dark brown; abdomen grey with whitish and dark grey segmental bands, the first two segments black-brown: fore wing with the central band broad throughout, slightly curved, and ochreous white until it is sharply angled round the discoidal whorl-shaped mark, the upper part from the angle to the costa quite white; the black ring of the whorl is correspondingly sharply angled, its inner side inwardly edged with white, the centre portion very obscure; the bill-hook is greyish pink ringed with black, and this colour runs right round the centre portion; all the upper portion of the wing is very dark, the subapical spot is fairly large, triangular, its lower point blunt, a small white dot outwards below it, followed by an irregular row of five white lunules outwardly edged with black, the first a double lunule, the lower lunules in a black suffusion, and a black angular patch outwardly edged with white on the hinder margin against the middle of the central band: hind wing with antemedial and medial blackish bands outwardly edged with ochreous grey; a subapical white lunule; a much curved and recurved black lunular discal line inwardly edged with whitish ochreous, greatly protruded outwards in its middle, with a blunt square and ochreous suffusion on each side and a blackish suffused patch below the subapical lunule. Underside pale brownish ochreous, the outer marginal space suffused with brown: fore wing with a whorl of whitish spots round the outside of the cell; a subapical spot, seven discal spots, the fifth well outside: hind wing with a black spot in the cell, two indistinct outwardly curved brownish lines in the middle; a subapical white lunule, a small white dot below it; a discal black lunular line, disposed as on the upperside.

♀. Very similar to the male.

Expanse of wings, ♂ $4\frac{1}{16}$, ♀ $4\frac{2}{16}$ inches.

Hab. Malang, Java.

Erebus philippensis, nov.

♂. Chocolate-brown, tinged with ochreous: fore wing with a thin obscure whitish line from the basal fourth of the hind wing running towards the apex, but not continued beyond the whorl-shaped discoidal mark, which it curves round and thickens somewhat towards the costa; the space above this line dark brown to the apex, but the portion beyond the whorl is without the white line; the whorl line is black as

usual; on the inner side inside the black line is a narrow pinkish-ochreous stripe, its lower end curved and broadened, and joining a large black patch; a thin greyish-ochreous middle line edged with black across the wing, with a small outward angle at its middle; a blackish suffusion on the lower disk; a subapical white rather large spot and four discal white spots in an irregular row, outwardly edged with black: hind wing with the base dark brown; an antemedial brown line with a pale outer edging; a medial somewhat crenulate greyish-ochreous line in continuation of the middle line of the fore wing; a subapical white spot; a discal indistinct greyish-ochreous line, more or less lunular, the hollows of the lunules filled in with black, the row deeply curved above its middle and then deeply and bluntly outwardly angled below its middle; body concolorous with the wings; the first two segments of the abdomen black, the third pale grey. Underside ochreous brown, the outer half dark, limited by a brownish thin band across both wings; the discal markings disposed as on the upperside, the white spots larger.

♀. Brown with a lilac tinge; abdomen with the first two segments black; wings of a uniform colour, the upper dark portion of the male only slightly indicated except towards the apex, which is dark; the whorl-shaped discoidal mark as in the male; a broad white band across both wings, broadest on the hind wing, its outer side with points like a fringe; the discal markings as in the male. Underside pale ochreous brown; the medial white band macular on the fore wing, broad on the hind wing; the discal markings as on the upperside.

Expanse of wings, ♂ 4, ♀ $4\frac{4}{10}$ inches.

Hab. Cape Engano, Luzon, Philippines.

Genus *PATULA*, Guen.

Patula does not possess the two curious chitinous plates in the connection between the 8th and 9th abdominal segments found in *Argiva*; Pl. XI. figs. 24, 25, 26, & 27 show the genitalia of the true *P. macrops*, drawn on the same plane as in the figure of the genitalia of *Argiva*. In the development of the coremata it agrees with *Argiva*; the structure of the valve and the shape of the penis are the chief points. The hind wing of the male has the costal half aborted, forming a fold turned over on the upper surface, containing a large glandular patch of flocculent hair; vein 4 runs to the functional apex, 5 from the middle of discocellulars, 6 to the fold, 7 and 8 very minute to near base of centre.

Patula moriola, nov.

♀. More or less similar in pattern to the common Indian species *P. macrops*, Linn., but the antemedial line ends hindwards in two conjoined rings, the lower one touching the hinder-margin; it is a smaller insect, much paler in colour, without the purplish glow of *patula*, the brown colour having a distinct ochreous tinge; it certainly cannot be the female of *P. macfarlanei*, which Hampson says is also to be found in Amboina, though the type came from Cape York in Australia, the markings being very different.

Expanse of wings, ♀, $5\frac{2}{10}$ inches.

Hab. Amboina Isl.

Patula oëdoxia, nov.

♂ ♀. Also very similar in pattern to *P. macrops*, but the outer transverse sinuous lines are farther apart on the fore wing and the submarginal line of the hind wing is not nearly so sharply doubled; it is a very large *Patula*, larger even than *macrops*, and the colour is quite different, being paler and more ochreous even than *moriola*. The genitalia, as might be expected, also differs from that of *macrops*; the valves of *P. macrops* are much broader, the penis is also different, there are larger bunches of cornuti and chitinous red, and the sacculus of the valves is much more developed (Pl. XI. figs. 26 & 27).

Expanse of wings, ♂ $6\frac{2}{10}$, ♀ $5\frac{8}{10}$ inches.

Hab. Alu Island, Solomons, a small island close to Shortland Island.

Two males, four females.

Patula ipsa, nov.

♂ ♀. Very similar in pattern to *macrops*, but paler in colour and is a smaller insect; the genitalia is also different; the penis agrees somewhat with that of *macrops*, but the valves are much narrower; the difference is shown in the Pl. XI. fig. 25.

Expanse of wings, ♂ 5, ♀ $5\frac{1}{2}$ inches.

Hab. Kandy, Ceylon.

Family **Noctuidæ**.*Brevipecten promona*, nov.

♂. Palpi white beneath, dark brown above; antennæ

grey; head, body, and fore wing dark grey, the ground-colour being white, thickly irrorated with dark grey atoms; thorax with a brown stripe down each side: fore wing with the lines darker grey, subbasal, from the costa to vein 1 indistinct; antemedial line slightly oblique from costa to hinder margin; medial line similar, its upper part lost in a large jet-black patch from the costa, its inner side deeply excavated and edged with white, a grey line closing the cell; postmedial line outwardly oblique from the costa, acutely angled and inwardly oblique to the hinder margin close to the termination of the medial line; marginal line crenulate, some brownish suffusion on the margin; cilia greyish brown: hind wing pale grey, whitish towards the base and abdominal margin; terminal line dark grey; cilia white on the lower half, grey upwards, intersected by a grey line. Underside: both wings evenly pale grey; a white subapical small patch on the fore wing, with a black spot on its inner side, which is in continuation of an indistinct grey discal transverse line.

Expanse of wings $1\frac{4}{10}$ inch.

Hab. Cape York, N. Queensland (*Dämel*).

Has some resemblance to *B. captatus*, Butler, from India, of which I have both sexes.

Capnodes asulca, nov.

♀. Head, body, and wings dark pinkish brown, very uniform in colour throughout: fore wing with a black spot in the cell and four in a cluster at the end; a curved dark mark on the costa near the apex, with a disjointed white streak on its inner half; a discal transverse sinuous row of white dots from the inner end of the streak across the wing, each dot with a black dot on its inner side; a row of subterminal black dots: hind wing with a discal row of similar white and black dots and subterminal black dots. Underside paler; a discal indistinct thin band and subterminal black dots on both wings; cilia brown.

Expanse of wings, ♀, $1\frac{4}{10}$ inch.

Hab. Khasia Hills.

Diomea nasea, nov.

♂. Very dark olive-brown, nearly black, very uniform in colour; palpi white on the inner sides, a white stripe on each shoulder; thorax and both wings with numerous round white spots: fore wing with costal spots at equal distances apart, with minute dots immediately below them; transverse rows

of basal, antemedial, postmedial, and submarginal spots and some medial white specks, the postmedial row consisting of three rows, the others of two rows and a marginal series: hind wing with indications of a medial white line and many white spots covering the outer half of the wing: legs with white bands.

Expanse of wings, ♂, $1\frac{3}{10}$ inch.

Hab. Kuching, W. Borneo.

Oræsia camaguina, nov.

♂. Palpi brown; head and collar orange; thorax and fore wing dark ochreous brown; very dark and uniform in colour on the fore wing, making the markings very obscure and difficult to trace; a darker streak on the median vein; an oblique-straight double line from apex to hinder margin, its upper half filled in with pale dull ochreous, a narrow brown shade from its middle to the lower end of the cell, then in a straight line to the middle of the hinder margin; two white ochreous patches on the outer margin, in its middle and at the hinder angle touching each other; cilia dark brown: hind wing white, the veins and streaks in the interspaces pale grey.

♀. Much as in *O. emarginata*, Fabr., from the Indian region, but all the markings on the fore wing more or less obscure.

Expanse of wings, ♂ $1\frac{2}{10}$, ♀ $1\frac{6}{10}$ inch.

Hab. Camaguin Island, near Manilla, Philippines (*Semper*).

Genus SERICIA.

Sericia, Guen. Noct. iii. p. 172 (1852), type *spectans*, Guen., from Australia.

Spiredonia, Hampson, Moths India, ii. p. 457 (1894) (nec Hübner).

Sericia sumbana, nov.

♂ ♀. Fore wing narrow, much narrower than in any other species of this genus; upperside with the ground-colour pinkish grey, suffused in parts with pinkish brown; markings much as in the common Indian species, *S. zamis*, of Cramer; the discal ocellus filling the lower curve of a figure of 8, small: hind wing of the same pinkish-grey ground-colour, with the usual familiar markings. Underside much paler and brownish grey.

Expanse of wings, ♂ ♀, $2\frac{8}{10}$ inches.

Hab. Sumba Island, south of Flores Island in the Timor Sea (*Doherty*).

I have four males and one female of this very distinct form.

Family Hypenidæ.

Genus GLOBOSUSA, nov.

♂. Antennæ unipectinated, palpi long and somewhat up-turned, the first two joints thickened and with stiff paired bristles, the last joint very slender, with bristles before its end; top of head with short thick hairs which protrude somewhat in front; all the legs naked, with very long spurs; both wings rounded in a circular form: fore wing broad, costa and hinder margin straight, cell broad, discocellulars nearly straight; vein 2 from a little beyond the middle of the cell, 3 from about halfway from it and the cell-end, 4 and 5 from the end; 6, 7, 8, and 9 deeply curved, 6 from upper end, 7, 8, and 9 stalked: hind wing with vein 2 from the middle of the cell, 3 and 4 on a short stalk, 5 from the cell-end, 6 and 7 from the upper end, 8 free, recurved, touches 7 near its base.

Type, *G. curiosa*, mihi.

A very curious-looking moth.

Globosusa curiosa, nov.

♂. Antennæ grey, palpi blackish brown, legs yellow striped with black on the upperside; head, thorax, and fore wing saffron-yellow: fore wing with faint indications of subbasal, antemedial, and postmedial grey lines; a blackish postmedial patch on the costa and black dots on the outer margin: hind wing yellowish white, indications of a recurved medial grey line, its lower part with black spots on veins 3 and 2 and two near the abdominal margin; indications of a postmedial outwardly curved grey line and black lunular spots on the outer margin. Underside uniform yellowish white; fore wing with a linear black spot in the cell, a smaller one at the end, small postmedial and subapical brownish marks; hind wing with a small lunular discoidal black spot.

Expanse of wings, ♂, 1 inch.

Hab. Saugir Island, south of the Philippines (*Doherty*).

Bertula adra, nov.

♂. Upperside : head, thorax, and fore wing dark olive-brown ; traces of antemedial, medial, and postmedial outwardly curved, somewhat sinuous brown lines ; a submarginal straight white line inwardly edged with dark brown from the costa near the apex to the hinder margin close to the angle : hind wing brownish grey, a faint brown lunule at the end of the cell ; traces of a medial outwardly curved brownish line ; a white submarginal line from close to the hinder angle, angled outwards, then crenulate upwards, and becomes obsolete before reaching the costa. Underside grey : fore wing with some brownish suffusion on the upper part, whitish along the hinder marginal space ; a postmedial, outwardly curved, crenulate brown line ; a straight brownish submarginal line ; the outer portion of the wing whitish : hind wing white, thickly irrorated with brown atoms ; a brown lunule at the end of the cell ; two outwardly curved crenulate brown lines, outwardly edged with white, corresponding to the two lines on the fore wing.

Expanse of wings, ♂, 1 inch.

Hab. Jaintia Hills, Assam.

Genus *WILKARA*, nov.

♂. Antennæ simple ; palpi upturned, very long, second joint very long, rising much above the head, densely hairy, third joint concealed by the hairs ; hind legs with the tibiæ densely hairy, the tufts of hairs extending, reaching halfway down the naked tarsi ; thorax crested ; abdomen smooth : fore wing narrow, costa nearly straight, apex somewhat rounded, outer margin convex, hinder angle somewhat rounder, hinder margin slightly convex : hind wing with the costa straight, apex and hinder angle rounded, outer margin nearly straight : fore wing with vein 2 from the middle of the cell, 3, 4, and 5 from the lower angle, 6 and 7 from upper angle ; a long brush of stiff straight hairs from the subcostal vein crossing the upper end of the cell, with some shorter similar hairs beyond it : hind wing with vein 2 from before the middle of cell, 3, 4, and 5 from the lower end, 6 and 7 from upper end, 8 free.

Type, *W. nigerrima*, nov.

Walkara nigerrima, nov.

♂. Upperside dark uniform black, with a slight lilac tinge: fore wing with a small white dot in the middle of the cell, a white spot at the end; a brown, nearly erect, antemedial line, a white subapical costal dot, a black apical spot; an oblique, straight, brown, thick line from this spot right across both wings, outwardly edged with whitish, to the abdominal margin of the hind wing beyond the middle. Underside: fore wing coloured like the upperside, the costal space above the subcostal vein pinkish grey, the outer veins streaked with pinkish grey; the brush of hairs grey: hind wing black, the abdominal space pale.

Expanse of wings $1\frac{4}{10}$ inch.

Hab. Kalim Bungo, Central Nias (*Kunnejieter*).

Bomolocha olypea, nov.

♂. Head, body, and wings dark pinkish grey: fore wing with the costal line black; a large medial black patch across the wing, its inner edge upright but bent inwards a little on the costa, its outer edge from one-sixth from the apex with many outward dentations to vein 3, then with a slight inward curve obliquely to the hinder margin a little beyond the middle; no other markings on either wing. Underside pale uniform brownish grey, fore wing with some blackish suffusion on the basal half.

Expanse of wings, ♂, 1 inch.

Hab. Mahableshwar, Bombay Presidency.

Bomolocha commixtura, nov.

♂. Upperside olive-brown; the ground-colour is really whitish, but the whole surface of both wings is densely irrorated with olive-brown atoms: fore wing with a black discoidal spot; traces of a whitish, outwardly curved, antemedial line; a postmedial white line, inwardly edged with black, outwardly oblique and incurved below the costa, then slightly sinuous, straight down with a slight incurve to vein 2, then with smooth inward curve to the hinder margin beyond the middle; traces of a white sinuous submarginal line; a white marginal lunular line outwardly black-edged; cilia with indistinct white inner line: hind wing paler; an indistinct, whitish, outwardly curved, postmedial, sinuous

line, the outer margin marked like it is on the fore wing. Underside brownish grey, with some greyish-white streaks in the interspaces.

Expanse of wings, ♂, $1\frac{2}{10}$ inch.

Hab. Lombok Island, between Bali and Sumatra.

Bomolocha variegata, nov.

♀. Palpi and head greyish ochreous, thorax greenish brown, wings greyish ochreous: fore wing with the costal line greenish brown, a patch of that colour in a triangular form filling the cell and the basal part of the next lower interspace; the outer part of the wing similarly coloured, an apical curved ochreous-grey streak in it which joins the ochreous-grey space between, the hinder portion of the wings ochreous grey; marginal line brown, crenulate, and with white points; cilia ochreous grey: hind wing without markings, the margins as on the fore wing. Underside ochreous grey, as also are the body and the legs: fore wing with a white spot at the end of the cell and two subapical white spots, the latter nearly obsolete in the type-specimen.

Expanse of wings, ♀, $\frac{9}{10}$ inch.

Hab. Kina Balu, N.-Borneo.

Bomolocha uniformis, nov.

♂. Palpi, head, thorax, and fore wing dark greyish ochreous; a blackish discoidal spot, no other markings: hind wing grey, also without markings. Underside: body, legs, and wings uniformly grey, no markings except for an indistinct darker grey discoidal spot on each wing.

Expanse of wings $1\frac{3}{10}$ inch.

Hab. Jaintia Hills, Assam.

Family **Nymphulidæ**.

Dracænura arfakalis, nov.

♂ ♀. Palpi brown, white beneath; collar grey; head, thorax, and fore wing dark purplish brown: fore wing with the veins blackish; a black spot in the cell and another at the end, no other markings: hind wing pure white; a brown marginal band with irregular inner margin, thickened some-

what at the apex : abdomen with the basal half grey, with some white on the segments ; anal half black, tuft white. Underside : fore wing paler, a black discoidal spot ; hind wing as on the upperside ; body and legs white.

Expanse of wings, ♂ ♀, 1-1 $\frac{1}{10}$ inch.

Hab. Arfak Mts., N. New Guinea, 4000' (Pratt).

EXPLANATION OF THE PLATES.

PLATE VII.

Fig. 1. *Maurilia instabilis*, p. 71.

Fig. 2. — *iconica*, p. 71.

Fig. 3. — *tunicata*, p. 71.

Figs. 3 a, 4. — *undaira*, p. 71.

PLATE VIII.

Fig. 6. *Carea subtilis*, p. 73.

Fig. 7. — *intermedia*, p. 73.

Fig. 8. *Acontia talauta*, p. 74.

Fig. 9. — *migrator*, p. 74.

PLATE IX.

Fig. 10. *Gadirtha impingens*, p. 70.

Fig. 11. — *guineana*, p. 70.

Fig. 12. *Amphipyra surnia* (Yokohama, Japan), p. 67.

Fig. 13. — *yama* (Asama Yama, Japan), p. 67.

Fig. 13 a. — *pyramidea* (England), p. 67.

Fig. 14. — *magna* (Punjab, India), p. 67.

PLATE X.

Fig. 20. *Argiva hieroglyphica*, p. 81.

Fig. 21. *Catocala fraxini*, p. 81.

Fig. 23. — *nupta*, p. 81.

PLATE XI.

Fig. 24. *Patula macrops*, p. 87.

Fig. 25. — *ipsa*, p. 88.

Figs. 26, 27. — *oxdovia*, p. 88.

IV.—*Some Mediterranean Bryozoa.*
By ARTHUR WM. WATERS, F.L.S., F.G.S.

[Plate XII.]

IN my collection there are many specimens which I have intended to describe or revise, but the description of various large collections has prevented, and I am glad now to make a beginning by dealing with five interesting forms—from Naples and Oran:—

Pedicellina hirsuta, Jullien.
Lepralia bifurcata, sp. n.
Lepralia circumcincta, Neviani.
Lepralia oranensis, sp. n.
Lagenipora ignota, Norman.

Pedicellina hirsuta, Jullien. (Pl. XII. figs. 1, 5.)

Pedicellina hirsuta, Jullien, 'Bryozoaires, Mission du Cap Horn,' p. 13, 1888.

The small specimen from Naples seems to correspond with Jullien's description, and has large recurved spines all over the zoecium, curved and pointed at the base, and their form suggests that they were movable. The peduncle is large and is also covered with spines, while the stolon is much narrower than the peduncle.

In my specimen I am not able to see clearly the base of the peduncle or the adjoining stolon, but believe it is correctly drawn. The contraction near the base has no appearance of being accidental, though more complete material is desirable.

This specimen was referred to in my description of the Red Sea Bryozoa*. It will be noticed that the zoecium and peduncle are very exceptionally large (calyx about 0.38 mm., peduncle about 0.11 mm.).

Loc. Ile Hoste, Orange Bay, 26 met.; Naples.

Lepralia bifurcata, sp. n. (Pl. XII. figs. 2, 3, 4.)

In specimens from Capri the zoaria have two branches bifurcating at a very wide angle (fig. 2 a).

Round the zoarium there are but few zoecia, from four to eight, either surrounding an imaginary axis or slightly flattened. The zoecia are irregularly quadrate, granular,

* Journ. Linn. Soc., Zool. vol. xxxi. p. 252 (1910).

having the oral aperture contracted at the side, with the part below the contraction narrower than the part above. At each side of the oral aperture there is a small, raised, rounded avicularium, and any of these may be replaced by a large spathulate one, in one case both avicularia being thus replaced. Usually the spathulate avicularia are directed distally, but one is diagonal, or it may be directed proximally. The bar to the avicularium has a small central denticle.

The granular ovicell is globular, widely open, so that the operculum cannot close the ovicell aperture. At the bifurcation there is a large round opening with a raised border (fig. 3), the object of the opening is not clear. It might have been for a large avicularium, or for a radicle, but the position does not make this probable.

It is much like the fossil *Characodoma halli*, Maplestone*, from Mornington and Mitchell River, Victoria, Australia, which, however, has the quadrate zoarium articulated, and the ovicelligerous zoecia are surrounded by irregular nodules; however, the shape of the zoecia is the same with the ovicell in the same position, but in *C. halli* there are small triangular or spathulate avicularia replacing the semicircular or spathulate ones of *L. bifurcata*.

Loc. Capri, 50 fathoms.

Lepralia circumcincta, Neviani. (Pl. XII. figs. 6-10.)

Hippoporina circumcincta, Neviani, "Bri. neoz. di alcune Loc. d'Italia," pt. 3, Bull. Soc. Rom. per gli Stud. Zool. vol. v. p. 118, fig. 7 (1896); Bri. postpl. di Spilinga, p. 28, fig. 11 (1896); "Bri. neog. delle Calabrie," Pal. Ital. vol. vi. p. 187 (73), pl. xvii. figs. 10, 11 (1900).

Lepralia grimaldi, Jull. et Calvet, Bry. de l'Hirondelle, p. 70, pl. ix. fig. 5 (1903).

Cheilopora circumcincta, Levinsen, Morph. & Syst. Stud. p. 353 (1909).

This does not appear to be uncommon at Naples, and Kirchenpauer left a manuscript description in the Zoological Station, calling it *Lepralia dohrni*. When the manuscript was shown to me, it was my intention to describe and figure the species, using the name given by Kirchenpauer, and I have sent away some specimens explaining that Kirchenpauer had given it this manuscript name.

When my paper on the Naples Bryozoa was written it had

* "Further Desc. of Tertiary Polyzoa of Victoria," Proc. Roy. Soc. Vict. vol. xiii. n. s., p. 7, pl. ii. fig. 17 (1900).

not come before me, nor had the specimens first met with any ovicells, but they occur from Oran and from Capri. Neviani evidently had very small pieces fossil, and did not describe any ovicell. He speaks of it as incrusting, though with fragments it might be difficult to be certain of this; from Naples and Capri it is unilaminate, whereas from Oran all except one piece are bilaminate, back to back. Jullien and Calvet, in describing *L. grimaldi*, do not say whether it is uni- or bilaminate.

Neviani described the surface as rugose, Jullien and Calvet say with small perforations, and both are correct as regards Capri and Oran specimens, which are covered by large granules and in between there are small pores. The nature of the granules varies in different parts and in some conditions they are the most noticeable, while in others the pores are the most distinct, but none could be described as smooth. The piece figured is very regular, but this is not always the case.

There is a small triangular avicularium at one or both of the upper corners of the zoecium.

There are about 27 tentacles in the Naples specimens.

There are usually 4 distal multiporous rosette-plates near to the basal wall and 4-6 lateral ones.

The ovicell is coarsely granular, but the granules are not so large as those figured by Jullien and Calvet. It is not raised, but shows beyond the oral aperture buried in the distal zoecium. The ovicelligerous zoecia have a much wider oral aperture than the ordinary zoecia, with the proximal edge straight, while the distal border forms the curve of a wide arc (see fig. 8). The ovicell has much the same shape as that of *Flustra foliacea*, L., passing to the basal wall, the wall between the distal end of the zoecium and the ovicell does not appear to be calcareous.

It is very difficult to know in which genus this should be placed. Neviani* made the genus *Hippoporina* for all species indicated by modern authors as *Lepralia*—that is to say, all that have a horseshoe-shaped oral aperture; he then mentions *H. pertusa*, Esper, which should therefore be the type of *Hippoporina*. In Part II. of the same paper, also 1895, he mentions *H. foliacea*, Ell. & Sol., and then *H. integra*, sp. n., which he figures. Canu calls this the type, but it is not the first mentioned. In Part III., 1896, Neviani mentions *H. imbellis*, Busk, and *H. adpressa*, Busk; then, further

* "Bri. neoz. di alcune Località d'Italia," 1895, p. 109, and Waters, "Bry. from Zanzibar," Proc. Zool. Soc. 1913, p. 515.

on in the same paper, he describes and figures *H. circumcincta*, nov., and *H. spilingæ*, nov. At one time, through an error in binding, I was misled into thinking *H. circumcincta* was the first mentioned and therefore the type of *Hippoporina*. Neviani also includes *H. edax*, Busk; *H. tessulata*, Rss.; *H. depressa*, B.; *H. complanata*, Norm.; *H. foliacea*, E. & S.; *H. pallasiana*, Moll. Neviani also described the genus as new in "Bri. foss. della Farnesina," Pal. Ital. vol. i. p. 107 (1895), where he mentions first *H. foliacea*, E. & S.—that is to say, in 1895 he described it as new in two places, in one mentioning first *foliacea*, in the other *H. pertusa*. Which of the papers was first published is not indicated, though in Neviani's 'Publicazione Diverse' the "Bri. neoz." comes first.

Canu*, in his "Bryozoaires des Terrains Tertiaires," includes under *Hippoporina* several fossil species, describing or mentioning the ovicells in all but two, but unfortunately his photographs only show them in three cases. *H. angustoma*, Rss., is included, but with its small roundish oral aperture it does not seem closely related to many of the species mentioned by Neviani.

Levensen† places *circumcincta* in his genus *Cheilopora*, in which some of the species have the ordinary and ovicelligerous zoecia similar, but in *circumcincta* and *præluclida* the ovicelligerous zoecia have different and larger oral apertures than the ordinary zoecia. One of my specimens of *præluclida* with an ovicell is from Tartary‡, and an ovicell has not been referred to by anyone else. It is globular, raised, perforated, and granular, about as wide as the zoecium, and is not directly closed by the operculum, for, as the ovicell is at a lower level than the operculum, connection with the ovicell is cut off when the operculum closes the oral aperture. The operculum of *L. sincera* has a nearly straight proximal edge with a thickened border parallel to the distal edge, and the operculum of *Cyclicopora prælonga*, Hincks, is very similar, so that it is unfortunate he gave the name *prælonga* to two species which may have to come into the same genus.

At one time the dimorphism, as seen in *circumcincta*, would have been thought sufficient reason for separating it gene-

* Ann. de Paléontologie, vols. ii.-iv. p. 77.

† Morph. & Syst. Stud. p. 353.

‡ The Tartary specimen has avicularia, as figured by Hincks, who, however, says no avicularia; so perhaps he did not recognise that they were avicularia, and in my specimens "from Singapore or the Philippines" there are none.

rically from forms in which it does not occur; but this cannot now be maintained. In Adeonellidæ this difference was made a generic character, but we now see that it only occurs in about half * the species. In *Lepralia* dimorphism is known in *depressa*, B.; *bistata*, Waters; *cineta*, Hincks; *cleidostoma*, Sm.; *circumcineta*, Nev. In *Hippothoa* it is sometimes found, as also in many Catenicellidæ; also in *Caleschara* and *Monoporella waipukerensis*, Waters, in *Cribrilina clithridiata*, Waters, and in *Schizoporella subimmersa*, MacG., &c.

In describing *Lepralia grimaldi*, Jullien says that the dimorphism of the zoœcia in this species is enough to shake our confidence in the characteristic value of the oral aperture, but the reason for this is not clear, for the opercula of the ordinary zoœcia will have the shape of the species both in colonies with or without ovicelligerous zoœcia, and it is therefore a character of the greatest use—besides, in some cases the relationship may also be shown by the ovicelligerous zoœcia.

I am not sure that *Hipporina* will stand as containing the present somewhat heterogeneous collection, nor do I feel at all satisfied with the family Hippopodinidæ, Lev., for *circumcineta* has not a thin-walled zoœcium, the nature and shape of the ovicell is very different in *circumcineta* and *præluçida*, and then the slight difference in the distal wall in *Cheilopora* and *Hippopodina* is a trifling character, the difference in the rosette-plates may or may not be of importance. Under the circumstances I, provisionally, at least, adhere to *Lepralia* of Hincks, and to me it seems that the wisest and simplest thing would have been to have done so generally, and to have gradually removed species to other or new genera when there was sufficient reason for so doing; for as time has gone on it has become clear that many things were incorrectly grouped together under *Lepralia*.

Loc. Naples, 45 fath.; Capri, 30 fath.; Oran, 54 fath. (specimens given by Canu); Bay of Biscay, 240 metres (J. & C.).

Fossil. Spilinga, Calabria, post-Pliocene (N.); Monteleone, Calabria, Pliocene (N.); var., Carrubare, Calabria, Upper Pliocene (N.).

* "A Structure in *Adeonella*," Ann. & Mag. Nat. Hist. ser. 8, vol. ix. p. 497 (1912).

Lepralia oranensis, sp. n. (Pl. XII. figs. 11-13.)

The zoarium grows as a hollow cylinder (2-3 mm. diam.), or irregularly, in places forming more than one layer.

The oral aperture is exceedingly long with a marked contraction about the middle, the lower edge being nearly straight or slightly curved upwards, and the distal half of the operculum is very thick, almost semiglobular. On each side of the zoecium there is a long narrow avicularium, directed distally and extending beyond the line of the aperture. Although there are several specimens, no ovicells have been found. The surface of the zoecium is irregular, but cannot be called granular, and in the Oran specimens pores are seldom visible, whereas in the Liberia specimens they are more easily followed, there being three or four on the front and some by the avicularium.

There are two distal rosette-plates near the basal wall.

When only some of the tubular specimens had been seen there was thought to be some similarity to *Fedora excelsa*, Jull., but this idea was abandoned on finding more material. There is often a groove-like mark on the dorsal surface.

In a box in Jullien's collection from Petit Tahou, Liberia, there were a considerable number of specimens, together with *Cupularia canariensis* and an erect *Porella*, and specimens therefrom of *L. oranensis* were given to me in the Musée d'Histoire Naturelle, Paris.

Loc. Oran, "zone coralligene," 54 fathoms; Petit Tahou, Liberia.

Lagenipora ignota, Norman. (Pl. XII. figs. 15-17.)

Lagenipora ignota, Norman, "Polyzoa of Madeira," Journ. Linn. Soc., Zool. vol. xxx. p. 309, pl. xlii. figs. 10-13 (1909); Osburn, "Bry. of the Tortugas Islands," Pub. Carnegie Inst. of Washington, No. 182, p. 214 (1914).

The zoecia are small, and there are very narrow vicarious avicularia placed upon a kind of mound. No zoecia have been found with two peristomial avicularia, whereas the central peristomial avicularium is well-marked, having a chamber much the same shape as that figured by Savigny for his *Cellepora lancreti*, in which the ovicells are different.

The ovicells have a row of pores within the ridge, as is usual in *Lagenipora*, whereas *L. socialis*, Hincks, to which I have frequently referred*, has a pore at each corner, and as

* Journ. Linn. Soc., Zool. vol. xxx. p. 174 (1907); Proc. Zool. Soc. 1913, p. 511; Proc. Zool. Soc. 1914, p. 856.

this has not been figured a somewhat diagrammatic figure is given (fig. 14). In various species besides the usual row of pores there may be one or two near the centre of the area, and in a specimen from Glenelg, South Australia, the whole of the ovicell area has numerous pores. This last is very closely allied to my *L. caminata*, in which a few pores may be seen between the rows. In *L. costazii*, Aud., besides the usual row of pores at the distal edge of the area, there is frequently another row at the proximal edge, as is also the case in *L. lacinosa*, Calvet, which may be *costazii*, Aud.

The two straight sclerites of the mandible (fig. 16) are quite similar to those of *L. lucida*, and I only know them in these two species and *L. caminata*. Something of the kind occurs in *Thalamoporella rozieri*, Aud.

The oblique peristomial avicularium, figured by MacGillivray in his *Lagenipora nitens*, occurs also in the 'Challenger' *L. bilabiata*, B.; in what has been called *C. granum*; in the *L. lucida*, H.; in *L. diadema*, MacG.

L. ignota, may be only an erect form of *L. lucida*, and there are many cases of *Cellepora* in which the young and the adult forms have received different names. Both have the diagonal peristomial avicularium and the long narrow avicularium.

Loc. Madeira, 70 fath. (N.); Tortugas, 12 fath. (O.); Oran, 54 fath. From material given by Mons. Canu.

EXPLANATION OF PLATE XII.

Fig. 1. Pedicellina hirsuta, Jullien, $\times 85$. *a*, spines, $\times 250$. From Naples.

Fig. 2. Lepralia bifurcata, sp. n., $\times 25$. *a*, natural size. From Capri.

Fig. 3. Ditto. $\times 25$. Showing the bifurcation and large round opening.

Fig. 4. Ditto. $\times 50$. Showing an ovicell and two spatulate avicularia.

Fig. 5. Pedicellina hirsuta, Jullien. $\times 12$.

Fig. 6. Lepralia circumcincta, Neviani. $\times 12$. From Oran.

Fig. 7. Ditto. $\times 85$. Operculum.

Fig. 8. Ditto. $\times 85$. Operculum of ovicelligerous zoecia.

Fig. 9. Ditto. Lateral wall, showing rosette-plates.

Fig. 10. Ditto. Distal wall,

Fig. 11. Lepralia oranensis, sp. n." $\times 25$. From Oran.

Fig. 12. Ditto. $\times 85$. Operculum.

Fig. 13. Ditto. $\times 85$. Mandible.

Fig. 14. Lagenipora socialis, Hincks. Showing ovicell, somewhat diagrammatic.

Fig. 15. Lagenipora ignota, Norman. $\times 50$. From Oran.

Fig. 16. Ditto. $\times 85$. Mandible.

Fig. 17. Ditto. $\times 85$. Operculum.

V.—*Notes on Asteroidea*.—II. By WALTER K. FISHER, Director, Hopkins Marine Station of Stanford University, California.

[Plate XIII.]

The Genus Freyella.—In a revision of the Brisingidae* recently published in this Magazine, I divided the old genus *Freyella* into two groups, *Freyella* and *Freyellidea*. I made *Freyella spinosa*, Perrier, the type of *Freyella*, since no type was designated originally. The old generic name was retained for those species which are distinguished by having united first adambulacral plates, a syzygial joint between the first and second adambulacral plates, conspicuous proximal marginals, the first of which is closely joined with its *vis-à-vis* to form a pair directly above the united first adambulacral plates, and by having, instead of two gonads to a ray, a considerable series along either side of each ray. Unfortunately none of these points except the first is brought out in Perrier's figures or mentioned in the description, since such details have generally been omitted as of no particular importance. In part they furnish a key for a natural generic analysis.

Through the courtesy of Dr. H. L. Clark, of the Museum of Comparative Zoology, I recently examined an authentic example of *Freyella spinosa* received from the Muséum d'Histoire Naturelle. It belongs to the group which I called *Freyellidea*. This specimen, no. 1447, has two gonads to each ray, each gonad consisting of a good-sized clump of tubules with a single aperture to the exterior. There is no syzygy between the first and second adambulacral plates; no syzygial joint between the upper end of the second and third ambulacral ossicles, although the interval is very narrow; there are no supero-marginals directly above the first adambulacrals. The first and second, and in one interbrachium also the third, adambulacral plates are joined to the corresponding adjacent plates of the next ray, although not so closely as in the other generic group, there being considerable tissue between the supposed plates. It was this feature, figured by Perrier, which led me to suppose that *F. spinosa* belonged with the group containing *F. fecunda*, *F. spatulifera*, and others, in which the first adambulacrals are always tightly joined. For the present it is best to consider this character

* Ann. & Mag. Nat. Hist. (8) xx. p. 418.

as of secondary importance in true *Freyella*, which is really not very closely related to the genus containing *F. fecunda*. The latter is distinguished by a syzygy, well-developed marginals for the interbrachium, and serial gonads.

For the genus, which I called *Freyella*, I propose the name *Freyellaster*, with *Freyellaster fecundus* (Fisher) as type. In this group belong *Freyellaster spatulifer* (Fisher), Macassar Strait, 901 fathoms; *Freyellaster scalaris* (A. H. Clark), Galapagos Islands, 812 fathoms; and probably also *Freyella polycnema*, Perrier.

The group which I termed *Freyillidea* will therefore become *Freyella*, with *Freyella spinosa* as type, and *Freyellidea* will drop out as a synonym.

The Genus Hymenodiscus, Perrier.—In the paper on the Brisingidæ above referred to, this genus was not placed in the synoptical key owing to lack of data. I have since

Fig. 1.

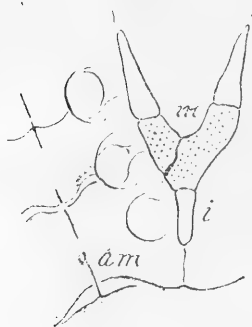


Fig. 2.

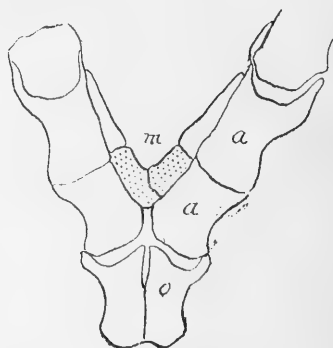


Fig. 1.—*Hymenodiscus agassizi*. An interbrachium from above first marginal plates, dotted.

Fig. 2.—*Hymenodiscus agassizi*. An interbrachium from actinal side. *a*, adambulacral plates; *am*, ambulacral plates; *i*, interradian; *m*, marginals; *o*, mouth-plates.

examined Perrier's type in the Museum of Comparative Zoology (no. 1448)*. The type of *Hymenodiscus agassizi* is almost certainly a very immature specimen, as it is small, and there are no gonads. There are no skeletal arches on the rays and the greater part of the thin abactinal integument

* For description see Perrier, 1884, 'Mémoire sur les étoiles de mer recueillies dans la mer des Antilles,' p. 189, pls. i. & ii.

has been removed. The fine spinulation of the disk extends upon the base of the ray. The abactinal integument of the ray, although very delicate, contains a single layer of lattice-work holothuroid plates, some of which at the very base of the ray bear minute spinelets. From this it would seem that the abactinal wall of the ray is destined to be similar to that of *Freyella*, unless in the fully adult animals the plates retain their embryonic character.

The interbrachium resembles that of *Brisingella*, but differs in having the first marginals (those which bound the apex of the interbrachial angle) unequal in size, as shown in the accompanying figures (figs. 1 and 2). In *Brisingella* these plates are equal, and the suture between the interradianal ends is on a line with the interradianal, or median oral, suture. There is a distinct syzygy between the first and second adambulacral plates. The interbrachia are not so open as in *Brisingella*, as the inner ends of the first adambulacral plates are normally in contact, or very nearly so. In an adult specimen we would expect to find these plates still closer together. It is worth noting that in *Freyellaster* and in *Brisinga*, s. s., the first marginal plates are of unequal size (see figs. 1 and 2, *m*, of "New Genera and Species of Brisingidæ"). Yet in its present juvenile form the interbrachial angle is different from that of either *Freyellaster* or *Brisinga*, while the entire absence of costal arches, as well as of gonads, may reasonably be attributed to immaturity. It does not seem possible to identify this problematical form with any other genus, except the even less known *Gymnobrisinga* of Studer.

Gymnobrisinga sarsii (Abhandl. Akad. Wiss. Berlin, Anhang, Abth. 2, 1884, p. 13, pl. iii., fig. 5) is based upon a brisingoid ray only. This lacks a dorsal skeleton, and while the large pedicellaria figured by Studer is different from those of *Hymenodiscus agassizi*, I am quite unprepared to offer an opinion as to the generic distinctness of the two species.

The Relationships of Labidiaster.—Although *Labidiaster* is very generally considered to be a member of the Brisingidæ, I would suggest that it has few essential characters in common with that family. The genus to which it exhibits greatest structural similarity is *Coronaster**, Perrier. *Coronaster*

* See Fisher, "The Asteroid Genus *Coronaster*, Perrier," Proc. Biol. Soc. Washington, vol. xxx. pp. 23-26, Feb. 21, 1917. *Coronaster* includes the following nominal species:—*C. parfaiti*, Perrier, type, *C. antonii*, Perrier, *C. briareus* (Verrill), *C. volsellatus* (Sladen), *C. octoradiatus* (Studer), *C. bispinosus*, Ives, *C. halicepus*, Fisher. I have examined

seems to be more nearly allied to *Pedicellaster* than to either *Heliaster* or to any of the recently proposed genera of Asteriidae. I would therefore place *Labidiaster* in the Pedicellasteridae. I have dissected a large example of *Labidiaster radiosus*, Lütken, from the Straits of Magellan.

Labidiaster differs from *Brisinga*, *Odinia*, *Freyella*, and similar genera in the following important particulars:— (1) Its abactinal skeleton is not duplicated in the Brisingidae; (2) forficiform, or straight, pedicellariae are present; (3) the adambulacral plates are crowded, very short in proportion to width, and entirely unlike in form and armature the same highly peculiar plates of all Brisingidae; (4) the ambulacra are shorter, especially the dorsal ends, which overlap, or imbricate with, the next adoral ambulacral plate, while in the Brisingidae there is no sign of imbrication, the ambulacra resembling the centra of chordate vertebrae, with vertical articulating adoral and aboral facets.

In the Brisingidae (in the narrower sense) the abactinal skeleton of the rays is variable, being in the form of transverse, independent, parallel ridges or costae, separated by areas of integument without plates; or the intervals may be partially or completely filled in with more or less imperfectly developed plates immersed in the body-wall; or the arches may be absent and a tessellation of thin plates may cover the genital region of the ray; or there may be thin plates, more or less spiniferous, together with differentiated transverse costae.

In *Labidiaster* the skeleton of the ray is closely similar to

volcellatus, *briareus*, and *halicepus*. *Coronaster* includes *Heterasterias*, Verrill, type *Asterias volcellata*, Sladen. In the above paper the following remarks occur:—"The family affiliations of *Coronaster* are not easy to determine, its lineage being somewhat involved. The tendency to crowding in the arrangement of pedicels partakes of the Asteriidae, while its mouth-plates are quite as 'brisingoid' as those of *Odinia*, and perhaps more so than the oral angles of *Labidiaster*, two groups placed in the Brisingidae. Its skeleton is more like that of a simplified *Pedicellaster* than like that of *Asterias* or allies. Parenthetically, the mouth-plates of *Pedicellaster* are more prominently 'adambulacral' than those of any genus of the Asteriidae, even of *Coscinasterias*, and are nearly or quite as prominent, relatively, as the oral angles of *Brisinga*. In *Pedicellaster* and *Coronaster* the ambulacral plates are more 'brisingoid,' uncrowded, and the pedicel-pores are in two series, even if later the feet themselves lie in four ranks. In very large specimens of *Coronaster* the pedicel-pores form two slightly zigzag rows, much less pronounced than in small specimens of *Coscinasterias* (in the broader sense), and the ambulacra are less crowded. My own feeling is that, until we arrive at a more satisfactory basis for the subdivision of the Asteriidae than is now current, it will be much better to leave *Coronaster* in the Pedicellasteridae."

that of *Coronaster*. There is a longitudinal series of trilobate infero-marginal plates, one of quadrilobate or cruciform supero-marginal plates, and one of cruciform median radial plates. The marginals and radials form regular transverse series. On the basal portion of the ray there is a more or less irregular zigzag series of trilobate dorso-lateral plates. The primary plates either connect directly by their slender lobes, or these are joined by one or two overlapping, oblong, intermediate ossicles. There results an open, fairly regular, reticulate skeleton having large tetragonal meshes (except where the dorso-lateral plates frame pentagonal openings). On the outer part of the ray the *longitudinal*, intermediate, connecting plates and the longitudinally oriented lobes of the marginals and radials gradually disappear, so that there remains only a series of independent, transverse, slender skeletal bands, simulating those of *Brisinga*, but having a very different history*. The skeletal meshes contain numerous papulæ. The form and armature of the adambulacral plates are as in *Coronaster*. The arrangement of the pedicellariæ either in retractile wreaths surrounding the spines or in retractile transverse cushions is not unlike that found in *Coronaster*†. The mouth-plates of the *Brisingidæ*, of *Coronaster*, *Pedicellaster*, and of *Labidiaster* are similar in general form, those of *Labidiaster* being relatively the smallest.

The features which are chiefly relied upon to distinguish the *Brisingidæ*, and to which the family in part owes its characteristic appearance, are conspicuous by their different form in *Labidiaster*. Such, in the *Brisingidæ*, are the elongate and peculiarly formed adambulacral plates; the long needle-like subambulacral and marginal spines, with their characteristic sacculate sheaths; the variable but always non-reticulate abactinal skeleton of the rays; the presence of only crossed or forcipiform pedicellariæ.

The genus *Rathbunaster* (type *Rathbunaster californicus*,

* Verrill, in his 'Monograph of the Shallow-water Starfishes of the North Pacific Coast,' 1914, p. 352, proposes a new genus, *Labidastrella*, for *Labidiaster annulatus*, Sladen. "It differs considerably in structure from *L. radiosus*, especially in having the dorsal and superomarginal plates nearly abortive distally, on the rays, beyond the genital regions." It is evident that this tendency to lose the dorsal skeleton of the distal part of the ray manifests itself in *L. radiosus*, and is carried further in *L. annulatus*. I agree with Kœhler that it does not form a safe basis for a generic division between two otherwise similar species (Kœhler, Ann. de l'institut océanographique, vol. vii., fasc. 8, May 1917, p. 8).

† See Sladen's figures of *Asterias* (= *Coronaster*) *volsellata*, 'Challenger' *Asteroidea*, pl. cvii.

from off California, deep water) was described by me as a neighbour of the curious polybrachiate *Pycnopodia* of Stimpson. I think the genus is related, instead, to *Coronaster*. It is notable for the suppression of the alternate superomarginal plates and the reduction of the abactinal skeleton to spaced circular plates without trace of connectives. The marginal and abactinal plates bear an acicular spine surrounded by a retractile sheath with an expanded distal crown covered with numerous pedicellariæ. The ambulacral, adambulacral, and oral plates are similar to those of *Coronaster*.

In *Labidiaster*, *Coronaster*, *Rathbunaster*, and certain genera of the Brisingidæ there are two gonads to each ray; each gonad opens upon the side of the ray at some distance from the base. All three genera, as well as the Brisingidæ, have a single ampulla to each tube-foot.

The family Pedicellasteridæ, if these views are correct, would consist of the subfamily Pedicellasterinæ with *Pedicellaster*, *Lytaster*, and *Gastraster*, and of the Labidiasterinæ with *Labidiaster*, *Coronaster*, and *Rathbunaster*.

Asterina coronata and *Asterina cristata*.—In the 'Archiv für Naturgeschichte,' vol. xxxii., 1866, p. 73, von Martens describes *Asterina coronata* from Batjan, Molucca Islands, and from Larentuka, Flores Island, and records its occurrence at Amboina. His description states that the relation of the minor to the major radius is as 1 to 2 or $2\frac{1}{3}$, that the abactinal plates are so arranged that the dorsal surface has a honey-combed appearance, the plates bearing five or more spinelets, and that scattered over the dorsal surface are groups of two to four heavy spinelets with a common base, such groups being found on the sides and radial regions of the ray, but not close to the border. On the disk these special spinelets outline an irregular pentagon.

In the 'Proceedings of the Biological Society of Washington,' vol. xxix., p. 27, Feb. 1916, I described *Asterina cristata* from the Caroline Islands, the special peculiarity of which is the presence of a variable number of abactinal plates (upward of fifty to a ray), elevated and tubercular in form, and surmounted by one to five unequal, robust, pointed spines, the largest being four or five times as long as the spinelets of the other plates, and many times greater in diameter. These elevated plates, with their tuft of enlarged spines, I take to be the same as von Martens's "Büschel von 2-4 starken Stacheln mit gemeinsamer Basis," which he says, "stehen auf den Armen ziemlich zerstreut, sowohl auf dem Rücken als an den Seiten, aber nie ganz nahe am Rande." Thus

the chief character of the two species is the same. As Dr. H. L. Clark has suggested in a letter, the two species are probably the same, although there exist certain discrepancies. Von Martens does not mention subambulacral spines, but states that the furrow-spines are "in einer Reihe, 4 oder 5 fast gleich Grosse auf jeder Platte," and that the actinal intermediate plates have two relatively long sharp spines. The type of *Asterina cristata* has two to four, mostly three, actinal intermediate spinelets, usually six furrow-spinelets webbed for about half their length, the three or four median conspicuously longer than the laterals, and usually four subambulacral spinelets, of which the two median are much longer than the laterals. I think it is possible that von Martens overlooked the small lateral furrow-spinelets, although not likely; but certainly in no specimens seen by me are the furrow-spinelets ever subequal.

The case is somewhat complicated by two specimens of a race of *coronata* which I saw some years ago in the British Museum. One was contained in a box with *Nepanthia maculata*, labelled "Migupon, 7 to 12 fathoms, fine sand and coral—Cuming." The other was labelled "Port Essington, Australia." In the first specimen there are twenty or twenty-five of the prominent plates to each fifth of the body. The actinal intermediate plates have, in the neighbourhood of the furrow, about five or six spines in a rude circle, one spine being longer than the others; near the ambitus there are three spinelets, with often one or two standing mesad from the principal comb. The furrow-spinelets are five or six, webbed, the laterals shorter than the mesial spinelets; the subambulacral spinelets are four or five, shorter and stouter than the furrow-spinelets, and also graduated in size, the mesial spinelets being longest*. I made no notes on the Australian specimen, but my impression is that it does not materially differ from the other.

Thus the actinal intermediate spinelets are more numerous than in the types of *coronata* and *cristata*, while the adambulacral armature is about the same as that of *cristata*. The prominent abactinal plates are fewer than in *cristata*, and more like the condition in Japanese specimens.

Dr. Seitaro Goto, in his work on Japanese Asteroidea, carefully figures and describes a species from the southern parts of Kyushu and adjacent islands which he calls *Asterina novæ-zelandiæ*, Perrier, but which I believe is a form of

* For the privilege of examining these and many other specimens of Asteroidea in the British Museum (Natural History) I am indebted to Professor F. Jeffrey Bell.

coronata, as it possesses the prominent abactinal plates so characteristic of *coronata*. Thus there are records from southern Japan to northern Australia.

As a beginning towards straightening the tangle of apparent races, I would suggest the subjoined scheme. Any further evidence for or against it, or in any way bearing upon the status of *Asterina coronata*, will be most welcome:—

- a*¹. Abactinal spiniform pedicellariæ present;
8 adambulacral furrow-spinelets; 8 or 9
marginal mouth-spinelets; 12 to 14 en-
larged abactinal plates *Asterina coronata eu-*
*erces** (Fisher). (Palawan.)
- a*². No spiniform pedicellariæ present; furrow-
spinelets 4 to 6; marginal mouth-spinelets
5 or 6.
- b*¹. Actinal intermediate spinelets usually
more than 3; near the furrow 5 or 6,
forming a circle or group (not a straight
comb); furrow-spinelets 5 or 6; 20 to
25 prominent abactinal plates to each
fifth of body *Asterina coronata fasci-*
cularis †, subsp. n. (Migupou; Port Essington?)
- b*². Actinal intermediate spinelets 2 or 3, but
not often 4.
- c*¹. Furrow-spinelets 4 or 5; actinal inter-
mediate spinelets usually 2; promi-
nent abactinal plates moderate in
number (up to 25 to each fifth of
body) and with as many as 25 spinelets
to a plate † *Asterina coronata coro-*
nata, von Martens. (Southern Japan, Batjan, Larentuka.)

* Fisher, Proc. Biological Society of Washington, vol. xxx., May 23, 1917, p. 91. Ulugan Bay (near mouth of Baheli River), Palawan Island, Philippine Islands, 2 to 5 feet, mud, sand, sea-weeds.

† This new race is certainly different as regards the actinal intermediate armature. Von Martens states that there are two spinelets in *coronata*. Of course, specimens may prove to be variable.

M. Alvin Seale, of the Museum of Comparative Zoology, who has lived many years in the Philippine Islands, tells me he has sailed past a fairly well-known *Migupou Point*; but I have not been able to locate it, with available maps, on Mindanao or on Luzon. Mr. Seale does not recall upon which of the two islands the point is found. It is quite possible that this is the locality from which so many of Gray's types were derived.

‡ So far as true *coronata* is concerned, the remarks concerning the number of prominent plates and the number of spinelets on these plates are conjectural. These observations refer to the Japanese form, described and figured by Dr. S. Goto ('A Descriptive Monograph of Japanese Asteroidea,' 1914, p. 650, pl. xix., figs. 279-281), which may, of course, be quite distinct from typical *coronata* of the Moluccan region.

- c². Furrow-spinelets 6; actinal intermediate spinelets usually 3 (2 to 4); prominent abactinal plates numerous (more than 30 and as many as 50 to each fifth of body) and with not more than 15 spinelets to a plate, frequently 10 or less *Asterina coronata cristata* (Fisher)*. (Caroline Islands.)

EXPLANATION OF PLATE XIII.

Type of *Asterina coronata cristata* (Fisher).

VI.—Is *Dicrocoelium lanceatum* a Parasite of the Cat? A Note on a new Variety. . By H. A. BAYLIS, B.A.

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[Plate XIV.]

REFERENCES have occasionally been made in helminthological literature † to the occurrence of "*Distomum lanceolatum*" ‡ in the cat. These cases have, however, in recent years been generally discredited, and it has been suspected that the parasites recorded belonged to one or other of the species of *Opisthorchis* or *Clonorchis* (*O. felineus* and *C. sinensis*) known to occur in cats, these forms being more or less similar to *Dicrocoelium lanceatum* in size and superficial appearance, though differing widely from it in their internal structure.

The typical *D. lanceatum* is a well-known parasite of sheep and cattle, and of various other herbivorous mammals; it is also an occasional, and probably accidental, parasite of man, having been met with some six times. Its occurrence in a carnivore, however, is a point with regard to which some scepticism is not unnatural. When, therefore, I received some time ago some Trematodes taken from the liver of a cat, I was greatly interested to find that they belonged undoubtedly to the genus *Dicrocoelium*, and differed from the typical *D. lanceatum* only in certain very small anatomical

* This form is probably distributed over western Oceania. It seems to be readily separable from the Japanese form, which has been classed as true *coronata*, although it probably is not.

† See, e. g., Leuckart, 'Die Parasiten des Menschen,' I., Abth. 2, p. 360; von Linstow, 'Compendium der Helminthologie,' p. 30.

‡ Synonymy: *Fasciola lanceolata* Rudolphi, 1803; *Distomum lanceolatum* Mehlis, 1825; *Dicrocoelium lanceolatum* Dujardin, 1845; *Dicrocoelium lanceatum* Stiles & Hassall, 1897.

details. These specimens, of which there is a considerable number, were collected at Georgetown, British Guiana, by Mr. G. E. Bodkin, Government Biologist, during November, 1915. They were kindly handed to me for determination by the Imperial Bureau of Entomology.

On a consideration of the many resemblances between these examples and the typical *D. lanceatum*, and of the minor points in which they differ from it, I am inclined to regard them as belonging to a well-marked variety of that species, rather than a distinct form. The one salient feature is the position of the testes, which in the specimens under consideration invariably lie symmetrically opposite to each other in the same transverse plane. All authorities are agreed in describing the testes of *D. lanceatum* as being placed nearly "tandem," *i.e.*, one behind the other, but somewhat diagonally, near the longitudinal axis of the body*. The exact position of the testes is, as a rule, a very constant specific character in Trematodes; but in this case the almost complete correspondence between the rest of the anatomy and that of the typical form seems to outweigh such a consideration. The only other differences that I have been able to find are in the somewhat smaller size of the cirrus-sac and the slightly larger average size of the eggs. Even the coils of the uterus show complete agreement, as far as they can be traced. For the sake of comparison, however, with the type, it may be worth while to give a fairly full description of the new variety.

The length of the worms varies between 5 and 7 mm., and the maximum widths for these lengths respectively are 1.62 mm. and 2 mm. The body is flattened dorso-ventrally, narrowing considerably from side to side in front, and less so behind. The posterior end is frequently somewhat rounded; sometimes, however, it is more pointed than in the example figured. To the naked eye the body is whitish and semi-transparent (in spirit), the masses of fully-formed eggs in the uterus being visible as blackish or brownish patches. The skin is smooth.

The oral sucker is subterminal, and has a diameter of

* Neveu-Lemaire ('Précis de Parasitologie humaine') gives a figure of *D. lanceatum* (reproduced in Brumpt's 'Précis de Parasitologie,' 2nd ed. 1913, p. 335), in which the testes are symmetrically arranged; but there is no reference to the source of the specimen from which the original figure was drawn, and no description of the internal anatomy is given in Neveu-Lemaire's work. The figure is, in other respects, very rough and inaccurate.

0.37 mm.*. The ventral sucker is situated 0.7 mm. behind it, and measures 0.4 mm. across. The mouth is followed immediately by a small, almost globular pharynx, measuring 0.15 mm. in length, and this is succeeded by an oesophagus 0.2 mm. long. The two simple intestinal diverticula extend backwards to within a little more than 1 mm. from the posterior end. They lie, for the greater part of their length, near the lateral margins of the body.

The excretory vesicle is small and inconspicuous. Its pore is terminal.

The genital pore is median, situated between the two suckers and at about the level of the bifurcation of the intestine. The testes are large compact bodies, slightly lobulated, especially on their lateral margins. They lie, as has been noted already, symmetrically opposite to each other, immediately behind and at the sides of the ventral sucker, and between the intestinal diverticula. Each testis measures about 0.8 mm. in length and 0.6 mm. in width. The ovary is a body of variable shape, but usually somewhat lobate; it is situated close behind the testes, but its position shows considerable variation. It appears to be rather more commonly situated on the right side than on the left, but in three out of eight stained examples the ovary was placed behind the left testis. There is a rather large rounded receptaculum seminis, situated just dorsally to the posterior edge of the ovary. Laurer's canal is present, and a shell-gland, not differing from that of the typical *D. lanceatum*. The cirrus-sac is about 0.4 mm. long and 0.15 mm. wide. It contains a coiled vesicula seminalis. The cirrus-sac participates in the variability of position shown by the ovary and its associated organs. Thus, when the ovary is on the right, the cirrus-sac lies to the right of the terminal portion of the uterus; when the ovary is on the left, the positions of the genital ducts are generally reversed.

The vitelline glands lie within the middle third of the body, and extend along the sides as a series of lobes of various sizes. The two vitelline ducts are given off somewhat in front of the middle of the glands, and cross the body to unite into a much wider single duct just behind the ovary.

The uterus fills almost the whole of the middle and posterior portions of the body, from the level of the anterior end of the vitelline glands to the tail. Its coils, for the most

* This and the following measurements are taken from an example 5 mm. long, and are therefore to be regarded as somewhat below the mean.

part, take the form of transverse folds and lateral loops. In the middle region these are confined to the space between the vitelline glands, but more posteriorly they sometimes extend laterally beyond the intestinal diverticula. The ascending limb of the uterus passes forward between, and ventrally to, the testes. The eggs are roundish-oval in shape, and when fully formed have a rather thick brown shell, usually showing an indentation on one side, so that in profile one side is convex, the other concave. The eggs measure $42.5-50 \mu \times 30-35 \mu$.

The variety described above I propose to call

Dicrocoelium lanceatum St. & Hass., var. *symmetricum*,

in allusion to the arrangement of the testes;

This variety being at present known only from specimens collected from a single host, a cat, it is doubtful whether it should be regarded as a "local" variety or as a form peculiar to cats. An examination of examples of *D. lanceatum* from sheep or other herbivorous animals in the same locality would be of great interest from this point of view, as well as a further investigation of the parasites of cats. In any case, it would appear that the older helminthologists may have been correct in reckoning the cat among the hosts of "*Distomum lanceolatum*."

EXPLANATION OF PLATE XIV.

Dicrocoelium lanceatum, var. *symmetricum*. Ventral view of a stained specimen. *C.S.*, cirrus-sac; *Int.*, intestinal diverticulum; *Ov.*, ovary; *R.*, receptaculum seminis; *T.*, left testis; *V.*, vitelline glands; *V.S.*, ventral sucker.

VII. — *The Eggs and Spawning-habits of the Pilot Fish* (Naukrates ductor). By J. D. F. GILCHRIST, M.A., D.Sc., Ph.D.

In the course of a general enquiry into the spawning-habits of Cape fishes, a mature female of the pilot fish was found. The eggs and larvæ of about thirty Cape fishes have been described in local publications, but, as the pilot and its peculiar habits are so well known, and have attracted attention in all parts of the world, a description of the mature eggs of this fish, hitherto unrecorded, may be worthy of a special note, and interest a wider circle of readers, more especially as the nature of the eggs seems to

throw light on some peculiarities in the behaviour of the fish.

The pilot fish is not uncommon in the Cape seas. The young are frequently abundant in the summer months, being found in company with the young of *Lichia amia*, which they somewhat resemble in the characteristic markings of the body. The adults are well known, under the name "Lootsman," to Cape fishermen, who state that they are always found accompanying a large shark, called the "Tornijn Haai" or porpoise-shark (*Charcharias melanopterus*). They take up a more or less constant position near the body of the shark, and remain within a few inches of the base of the pectoral fin. The fishermen have also noted that they have the habit of darting away from the shark towards any strange object, and then returning to their former position. This well-known behaviour, interpreted in other parts of the world as a guiding or piloting of the shark to its food, the Cape fishermen believe, is for the purpose of a preliminary tasting or testing of the food on behalf of the shark.

On one occasion, in the month of December, a specially large pilot fish was caught on the hook by some fishermen fishing off Cape Point. It was in the company of a porpoise-shark. By placing the fish in a bucket of water, it was possible to keep it alive, and convey it to the Marine Laboratory at St. James, where it was placed in a large tank, and seemed none the worse for its capture. It proved to be a mature female with ripe eggs, which were extruded on slight pressure.

These extruded eggs were readily seen, being large, though quite transparent. When placed in water, however, they became almost invisible. They did not float, and they adhered to each other and to objects with which they came in contact. The shape of the eggs was distinctly oval, though a few were more rounded. A typical example, shown in the accompanying figure (p. 116), measured 1.74 mm. in length and 1.3 mm. in greatest breadth. In another case the measurements were 1.65 \times 1.39 mm. There were very minute dots on the surface of the egg, and from one pole originated a single fine filament. This was of considerable length, being in one case six times the length of the egg, or about 10 mm. In most cases it was shorter, and in some it appeared to have broken off close to the egg. The filaments readily became entangled with each other, so that it was difficult to separate out any particular one without breaking it. At its base the filament had a broad attachment to the outer membrane, of which it is apparently

a modification. At this point it was about $\cdot 04$ mm. in diameter, but soon diminished to about $\cdot 016$ mm. The filament appears to be homogeneous throughout, but, if treated with hot caustic potash, it has the appearance of a thick-walled tube.

At the distal pole of the egg, opposite that from which the filament arises, there is a marked differentiation of the surface of the egg, on a small terminal area about $\cdot 2$ mm. in diameter. This area is covered with clear polygonal markings, which vary in size, being large towards the periphery, where they fade off into the surrounding surface. Near the centre they become smaller and less distinct, and



Egg and filament of *Naucrates ductor*.

pass into a small thickened ring, in the centre of which the micropyle may be clearly seen.

There is a large perivitelline space, about a fourth of the diameter of the whole egg in breadth at the middle of the egg. In the specimen figured this breadth was $\cdot 32$ mm.

The egg proper or yolk is an ovoid mass, somewhat more oblong in shape than the outer shell of the egg. It is clear, but granular, and no traces of vesications nor oil-globules were seen. In preserved material several cases were observed in which the yolk had shrunk away from its surrounding perivitelline substance, and, in such cases, at the distal end opposite the micropyle, a small funnel-like

projection appeared, which in the normal condition would penetrate the yolk-mass to a slight extent. It doubtless has some function in the mechanism of fertilisation, though no canal connecting it with the microphyle was detected in the perivitelline substance.

The mode of origin of the filament of the egg is different from what is found in some other filamentous eggs of Telcosts. Thus, in the egg of the South African species of *Hemirhamphus* and *Atherina*, I have noticed that, in the immature and even fairly small ovarian eggs, the filaments occur as irregular streaks on the surface of the zona radiata, but, in those of *Naucrates*, the filament is already free, and serves to attach the egg to the wall of the ovary. A number of such filaments are inserted at one spot, so that the ovarian eggs are often grouped in grape-like clusters, or the filaments become twisted on each other to form a rope-like structure, round which the eggs are grouped.

The presence of filaments on fish-eggs, as a rule, has been found to be associated with the fact that they are anchored to each other or to foreign objects, floating or lying at the bottom of the sea. Thus the eggs of *Hemirhamphus*, *Belone*, and *Exocætus* have been found attached to each other and to sea-weed in this way, though *Scombresox*, another member of the same family, is said to have pelagic eggs provided with filaments. Another family, the Atherinidæ, all the members of which have eggs provided with filaments, so far as is known, have demersal attached eggs.

There is thus a reasonable presumption that the possession of filaments indicates that the eggs are, ultimately at least, attached to some object fixed or floating in the sea, and, if we suppose that the filamentous eggs of the pilot fish are attached to the shark, with which the fish is so intimately associated, it may explain some peculiarities in its habits which have received a variety of explanations. These are not entirely convincing, partly on account of this variety, but chiefly on account of conflicting facts or of lack of confirmation.

Thus the explanation that the pilot feeds on the fragments of the food of the shark is not in accordance with the fact that small fish have been found in its stomach. The same objection applies to another conjecture that it feeds on the excrements of the shark, and still another that it feeds on the parasites on the skin of the shark. An explanation of a different nature, that the pilot keeps close to the larger fish for the purpose of protection from its enemies, is a more plausible one, but is somewhat strained when its very close

proximity is explained as a precaution against the attack of the shark itself. It is not in accordance with the supposed amicable arrangement whereby the pilot is allowed to have a share of food or excrement, in return for its piloting services. According to actual observation, the shark is not at all disconcerted by the absence of the pilot, but the pilot is said to be greatly agitated by the loss of the shark. It has even been observed "clinging to the side of a shark," and, on one occasion, it is stated that it was seen to leap out of the water in an endeavour to follow a shark which had been caught by hook and was being hauled on board a ship.

Another peculiarity in the behaviour of the fish, which seems to be of some significance in this enquiry, is the well-known fact that it sometimes accompanies large sailing-ships, which it follows so persistently that it is drawn far away from its natural habitat. It even follows the ship into the harbour, where it is easily caught.

Most of these peculiarities would be sufficiently explained if we suppose the pilot's eggs to be attached to the rough skin of the shark, or to the bottom of the ship, which is so persistently followed. We may recall in this connection the solicitude of such fishes as the Blennies for the safety of their eggs, how they keep close guard over them, driving off any approaching intruder. The close proximity of the pilot to the shark, the darting forward towards any strange object (which seems to be an undoubted fact), the persistence in following the shark or the ship in circumstances which are unfavourable to its own welfare, would seem to indicate a very powerful motive, not dissimilar to that of the fishes which guard their eggs.

The fact that the young stages of *Naucrates* are frequently got, but that no pelagic eggs such as those above described have, so far as I can ascertain, been procured in tow-nets, seems to have some further significance in this enquiry and to indicate that the eggs of *Naucrates* are not floating.

The only sufficient proof of the suggestion here offered would, of course, be the finding of such eggs attached to the body of a large shark or ship, which had been accompanied by a pilot fish, and it may be that, with the above-mentioned facts in view, the opportunity may arise for the solution of the long-standing mystery of the pilot fish.

VIII.—Notes upon the Sika-Deer of North China.

By ARTHUR DE CARLE SOWERBY, F.Z.S., F.R.G.S.

THE opportunity has recently been afforded me of examining a fully adult Sika stag, shot by Mr. J. Holmberg, of Tientsin, in the Fen-chou Fu district of West Shansi, during December 1916.

Previous to this, I believe, no complete specimen of this animal has ever been secured by a European; while, as far as I know, the only reference to it in any publication is that by Père Heude in his 'Mémoires concernant l'Histoire Naturelle de l'Empire Chinois' (tome iv. p. 210, pl. xxxvii. fig. 13), wherein he names the species *Cervus grassianus*, from a single pair of antlers from Tching-lo-hsien (Tsing-lo Hsien), Shansi. In a paper written by me on Père Heude's collection of pigs, sika, serows, and gorals in the Sikawei Museum, Shanghai, and published in the 'Proceedings of the Zoological Society of London,' April 1917, pp. 7-26, I suggested that the Shansi sika should be classed for the time being with Milne-Edwards's *Cervus mandarinus*, though I stated then that winter skins that I had seen were lighter in colour than the figure given by Milne-Edwards.

The stag which Mr. Holmberg so kindly allowed me to examine is, however, fully as dark as Milne-Edwards's winter figure, though in this connection it is interesting to note that Mr. Holmberg states that the hinds and young that he saw with the stag were very much lighter. This agrees with my own observations. I have had no opportunity of determining whether or not the hinds and young of the Chihli sika are lighter than the stags; but as a result of my examination of Mr. Holmberg's specimen I do not hesitate to confirm Père Heude's separation of the Shansi sika from the other Chinese forms, and, although he gave no description, the fact that he gives a figure of a pair of antlers from Tsing-lo Hsien, West Shansi, makes his name hold good. Following is a diagnosis and description of the species:—

Cervus grassianus, Heude.

Cervus grassianus Heude, 'Mémoires concernant l'Histoire Naturelle de l'Empire Chinois,' tome iv. p. 210, pl. xxxvii. fig. 13.

A single fully adult male in winter pelage examined, also two winter skins of fully adult females, and a summer skin of a male, as well as two fully developed pairs of antlers, all from West Shansi.

♂ complete, from mountains 100 miles S.W. of Fen-chou Fu, Shansi, N. China.

Measurements in the flesh:—Head and body 60", height at shoulders 42", tail 8", hind foot $16\frac{1}{2}$ ", ear 7". Weight 165 catties=220 lbs. (about).

Colour. A general greyish brown on the head, going into brown on the forehead and a pale buff at the base of the horns and the base and backs of the ears, the inside of the ears being white. Nose dark brown; chin dark brown, almost black, with a small white patch on either side. Area round the eye buffy-grey. The general colour gets darker on the neck, but it still retains a wash of buff or ochre. The body is dark greyish brown, with a slight indication of a darker median dorsal line. The spots are almost invisible, showing up in certain lights and quite invisible in others. The dark greyish brown of the body shades into a rich brown on the back and lower portions of the legs, getting lighter and more ochraceous on the fetlocks. There is a peculiar patch of long white hairs surrounded by black on the outer surface of the hind leg about 6 inches below the heel. The tail is black above, white beneath, the hairs being long and making the tail somewhat bushy. The croup disk is white, edged with black on its upper half, the black joining up with that of the upper tail surface, so that there is no white between the tail and the back. The under surface of the belly and inner surface of thighs are white; the chest is a dark brownish grey.

The hairs of the neck are considerably longer than on the rest of the body.

Horns. The horns in this specimen are not very well developed, being past their prime. They measure:—

Right, $19\frac{1}{2}$ " in length.

Left, $19\frac{3}{4}$ " "

Right, above the brow-tine $3\frac{5}{8}$ " in circumference, below $5\frac{7}{8}$ ".

Eight points, 4+4.

Other horns examined are large, graceful, and heavy, but not so large as is usual in *C. mandarinus*.

Skull. Condyllo-basal length 322 mm.; zygomatic width 136 mm.; interorbital space 100 mm.; length of nasals 125 mm.; greatest width of palate (at post-molar) 54 mm.; greatest width of cranium 84 mm.; length of upper tooth-row 99 mm.; length of lower tooth-row 103 mm. Teeth well worn.

Type. A pair of antlers in the Sikawei Museum, Shanghai, no number, from Tching-lo-hsien (Tsing-lo Hsien), Shansi.

The habitat of this species may be considered as confined to the forested and mountainous areas of that part of Shansi

that lies west of the Fen Ho. Even here it occurs only in a few isolated districts, namely:—

1. The forest to the south of Ning-wu Fu, west of Tsing-lo Hsien and north of Ko-lan Chou, where Heude's specimen was doubtless secured.

2. In the forested area 90 miles west of Tai-yuan Fu, known as the Chiao-ch'êng Shan.

3. In the forested area 100 miles south-west of Fen-chou Fu, known as the Ning-hsiang Hsien mountains.

Formerly its range extended throughout the whole of the mountainous area of West Shansi, as well as in the mountains that extend in a north and south line between Shansi and Chihli; but it has been almost exterminated by native hunters for the sake of its horns, which are highly valued as medicine. Only a few isolated herds occur in the districts above mentioned, where they keep to the densest parts of the forest. Even so, they are being steadily exterminated.

This sika ruts in November and December, sheds its horns about March, the new growth commencing about the end of July. It is during August and September that this species is most sedulously hunted by the natives, for then the horns are considered to be in their prime.

Following is a diagnosis of the sika occurring in the Chihli forests:—

Cervus mandarinus, Milne-Edwards.

Cervus mandarinus Milne-Edwards, 'Recherches pour servir à l'Histoire Naturelle de Mammifères,' vol. i. (text), pp. 184-186, vol. ii. pls. xxii. et xxiii.A.

This sika differs from *C. mantchuricus*, Sw., in having the white spots larger and fewer in number, in being generally lighter in colour, with less white on the croup disk, and in having the parts below the belly the same colour as the flanks, instead of white. The differences in the winter pelage are not so marked.

Milne-Edwards states that the spots in *C. mantchuricus* in the winter pelage are so invisible as not to have been given in Sclater's figures. (In this it resembles the Shansi stag.)

In *C. mandarinus*, in spite of the general darkening of the pelage, the spots remain plainly visible.

In a letter published in the P. Z. S. 1865, No. 1, p. 142, Swinhoe retains the name *mantchuricus* for the Manchurian sika, having examined a living specimen at New-chwang in South Manchuria. He makes the statement that he suspects it to be the same as the deer, skins of which he secured in the Summer Palace, and which Blyth called *mantchuricus*

(P. Z. S. 1864, p. 109), but which Swinhoe himself subsequently called *hortulorum* (P. Z. S. 1865, p. 1).

As there is no telling where the deer confined in the Summer Palace came from originally, it being just as likely that they were brought from Manchuria as from the Imperial Hunting Grounds, owing to the fact that part of the tribute annually paid to the Imperial Manchu household from Manchuria consisted of game of various kinds, and since Milne-Edwards finds the Chihli species so distinct from the Manchurian form, it seems more than likely that Swinhoe's surmise as regards the common identity of his skins from the Summer Palace and his New-chwang specimen was correct; in which case his name *hortulorum* applying to the Manchurian sika is later than his name *mantchuricus*, and so becomes a synonym, thus leaving Milne-Edwards's name *mandarinus* clear for the Chihli specimen.

This species occurs in a wild state only in the Imperial Hunting Grounds, north of the famous Tung Ling (Eastern Tombs), and in the Wei-ch'ang to the north of Jehol, both in Chihli province, to the north and north-east of Peking. It occurs in a semi-domesticated state in the magnificent park at Jehol.

Up to recent times this deer has been strictly preserved, but in 1911-12 the Manchu soldiers that were sent out of Peking and were camped in the Eastern Tombs and Imperial Hunting Grounds were allowed to kill as many as they liked, while since that date native hunters have been allowed to hunt in these districts, with the result that in the wild state the species is practically extinct.

It may here be stated that unless immediate and very stringent steps are taken for their protection, both *C. grassianus* and *C. mandarinus* will become extinct, and the sika no longer remain on the list of North China mammals.

IX.—*Descriptions of new Genera and a new Subspecies of South American Birds.* By CHARLES CHUBB, F.Z.S., M.B.O.U.

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PSEUDOCONOPHAGA, gen. nov.

The proposed new genus, which is based on *Conopophaga melanogaster*, Menetr., is distinguished from *Conopophaga*, founded on *Turdus auritus*, Gmel., by its long and narrow bill, the long tarsi and toes, the larger size, and different coloration.

Type, *P. melanogaster* (Menetr.).

MACKENZIAENA, gen. nov.

Reichenbach, in 1850, proposed the generic name *Nisius*, and gave a figure in his *Av. Syst. Nat. Vög.* pl. lxxi., which has been associated by previous authors with *Thamnophilus leachi*, Such, as the type; but, when that bird is compared with the figure, it will be easily seen that Reichenbach could not have founded it on that species, as it is not anything like it. The species was originally, and has for many years been, placed in the genus *Thamnophilus*, Vieillot, where it was equally out of place, as it is so entirely different from that genus, which was founded on *Lanius doliaatus*, Linn. I propose, therefore, the new generic title *Mackenziaena*, with the following characters:—Head not crested, no concealed white dorsal patch, tail much longer than the wing. Bill short and stout, the depth about two-thirds the length of the exposed culmen. The wing, which is rounded, has the fifth primary longest. The tail is also rounded and much graduated, the two middle feathers longest. Coloration: the male is black, with ovate white spots and bars to the feathers, and the female is brown marked with buff.

Type, *M. leachi* (Such).

FREDERICKENA, gen. nov.

The species which I propose to separate as a new genus under the above title has also been previously placed in the genus *Thamnophilus*, Vieillot, with which it has no near affinity; it may be characterized by the absence of a concealed white dorsal patch. The nuchal crest is composed of rather broad feathers with rounded tips. The bill is short and stout, the depth being equal to about one-half the length of the exposed culmen. The wing is rounded, the fourth, fifth, and sixth primaries longest and subequal; the seventh is longer than the third, but shorter than the fourth. The tail, which is rounded and graduated, is about two-thirds the length of the wing. The male is almost uniform in colour, but the female has the tail and entire under surface barred.

Type, *Thamnophilus viridis*, Vieillot.

PICROTES, nom. nov., pro *Lochites*, Cab. & Hein. 1859
(nec Gistel, 1848).

Type, *Lanius severus*, Licht.

SAKESPHORUS, nom. nov., pro *Hypolophus*, Cab. & Hein.
1859 (nec Müller & Henle, 1837).

Type, *Lanius canadensis*, Linn.

POLIOLEMA, gen. nov.

This form is readily distinguished in having the throat uniform with the rest of the under surface. The bill, which is long compared with the other genera of this group, has the exposed culmen about equal in length to the hind toe and claw. The wing is rounded, the third, fourth, and fifth quills longest, the second about equal to the seventh. The tail is short and nearly square, the outer feather on each side is only very slightly shorter than the rest. The feet are small and weak. The male and female are entirely different in colour. I propose, therefore, that this form be separated generically under the name of *Poliolema*.

Type, *Myrmotherula cinereiventris*, Sclater & Salvin.

DICHROPOGON, gen. nov.

The species which I propose to separate generically have hitherto been associated with *Hypocnemis* of Cabanis, but it differs altogether in colour as well as in its proportionate measurements. The bill is small and narrow. The wing, which is slightly pointed, has the third, fourth, fifth, and sixth primaries longest, the second about equal to the eighth. The tail, which is nearly square at the tip, is about two-thirds the length of the wing. The legs and feet are proportionately strong, the tarsus exceeds the length of the exposed culmen by about two-fifths. Male and female quite different in colour of plumage.

This genus is based on *Hypocnemis pæcilonota*, Cabanis.

Rhopias fulviventris salmoni, subsp. n.

Adult male. Differs from the adult male of *R. f. fulviventris* (Lawr.) in being uniform olive on the top of the head, back, and sides of face, instead of greyish brown; upper wing-coverts pale brown, not blackish; tail paler; the white on the throat more extensive; breast buff instead of slate-grey; abdomen and under tail-coverts paler and inclining to buff; under surface of quills pale brown, not blackish brown.

Total length 110 mm.; exposed culmen 12; wing 50; tail 37; tarsus 17.

Adult female. Differs from the adult female of *R. f. fulviventris* in being paler both on the upper and under surface. Wing 50 mm.

Hab. Colombia and Ecuador.

The type, which is in the British Museum, was collected by T. K. Salmon at Remedios, Northern Colombia.

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No. 8. AUGUST 1918.

X.—*On some External Characters of Ruminant Artiodactyla.*
—Part II. *The Antilopinæ, Rupicaprinæ, and Caprinæ,*
with a Note on the Penis of the Cephalophinæ and Neo-
traginæ. By R. I. Pocock, F.R.S.

THE first part of this series of papers, supplementary to the account of the "Cutaneous Glands of Ruminants" published in 1910 (Proc. Zool. Soc. pp. 840-986), was issued in the Ann. & Mag. Nat. Hist. for June of this year, pp. 426-435. It dealt with the Cephalophinæ, Neotraginæ, Oreotraginæ, and Madoquinæ. The present communication comprises the Antilopinæ, Rupicaprinæ, and Caprinæ, the most interesting forms described being the two Rupicaprine genera *Capricornis* and *Budorcas*, of which I had only defective material for examination in 1910.

As in the previous paper, the pagination inserted after generic and specific names refers to the original treatise published in 1910.

Subfamily *ANTILOPINÆ*.

Genus *GAZELLA*, Licht.

In 1910 (P. Z. S. pp. 887-893) I described the preorbital, inguinal, pedal, and carpal or knee-glands in the following species of this genus:—*G. bennettii*, *subgutturosa*, *marica*, *muscatensis*, *dorcas*, *pelzelni*, *cuvieri*, *rufifrons*, and *sæmmerringii*. My descriptions were based upon fresh examples of all

Ann. & Mag. N. Hist. Ser. 9. Vol. ii.

the species except *G. sæmmeringii*, for which I was dependent upon a dried skin. Since that date I have been able to confirm my observations upon additional and fresh material of *G. bennetti*, *subgutturosa*, *rufifrons*, *dorcas*, *pelzelni*, and *sæmmeringii*, and can now add to the list one previously unexamined species—namely, *G. dama*.

Some notes upon the examples of *G. sæmmeringii* and *G. dama* may be of interest.

Gazella sæmmeringii berberana.—Specimens from Somaliland (R. E. Drake Brockman). The preorbital gland is of moderate size or small. The pedal glands are quite normal. The inguinal glands are shallow wide-mouthed pouches external to the mammæ. The carpal glands are thick pads of skin, covered with a mat of convergent hairs.

In a male example the secretion from the inguinal glands smelt like sour milk. In a female the secretion from the same glands, like that from the knees, had a strong ovine scent, like that of a pen of domestic sheep, whereas the waxy secretion from the pedal glands resembled dogs' dung in odour.

The rhinarium (fig. 1, I) is a little less reduced than in typical gazelles, in which it consists of hardly more than a small irregularly pentagonal area of naked skin restricted to the septum between the nostrils (fig. 1, G, H). But in *G. sæmmeringii* its upper edge is slightly expanded and spreads a little to the right and left, partly hanging over the nostrils above.

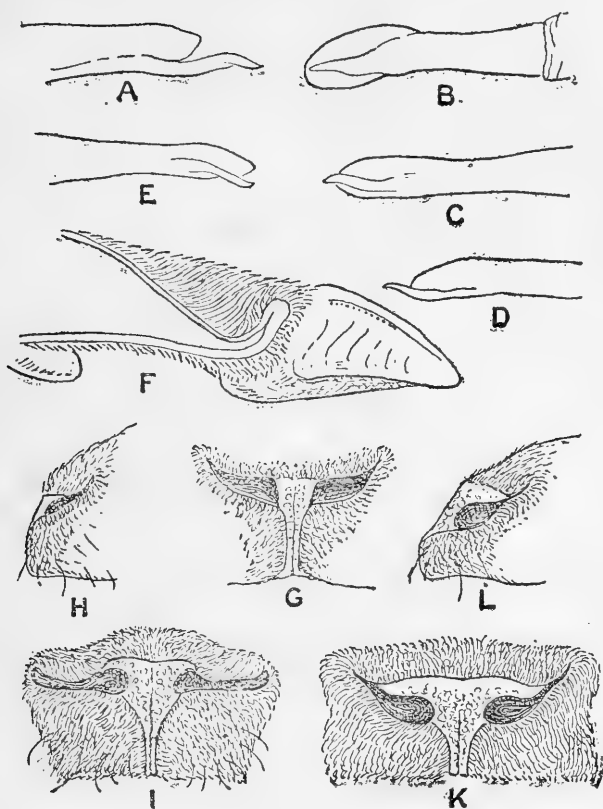
In the penis (fig. 1, B) the tubular prolongation of the urethra is short, barely projecting beyond the tip of the slightly swollen termination of the glans. It is shorter than in ordinary gazelles—e. g., *G. bennettii* (fig. 1, D) and *G. rufina*, figured by Lönnberg in 1904.

Gazella dama ruficollis.—Examples (♂ ♀) from the Soudan (G. Blaine). The preorbital gland is a shallow pit, quite small as compared with that of the typical gazelles. The pedal glands are quite normal. The inguinal glands consist of a pair of very shallow wide-mouthed pouches, one on each side just external to the corresponding mamma. The carpal or knee-glands, on the contrary, are rather exceptionally well developed, consisting of a pad of thick skin, overgrown with a mat of mesially convergent hairs covered with scurfy secretion.

The end of the penis in this species is slightly enlarged and the urethra is prolonged as a thin tube a little beyond the tip of the glans (fig. 1, C).

It has been suggested that the three large white-rumped

Fig. 1.



- A. Extremity of penis of *Antilope cervicapra*.
- B. The same of *Gazella sæmmeringii*.
- C. The same of *G. dama*.
- D. The same of *G. bennettii*.
- E. The same of *Antidorcas marsupialis*.
- F. Section of the fore foot of *Lithocranius walleri*.
- G. Rhinarium of *Gazella rufifrons* from the front, $\times \frac{1}{3}$.
- H. The same from the side.
- I. The same of *Gazella sæmmeringii* from the front, $\times \frac{1}{3}$.
- K. The same of *Antilope cervicapra* from the front, $\times \frac{1}{3}$.
- L. The same from the side.

African gazelles—*G. granti*, *sæmmeringii*, and *dama*—connect the smaller typical African and Asiatic gazelles with the springbuck *Antidorcas*; and Lydekker and Blaine (Cat. Ung. Mamm. iii. p. 85, 1914) adopt for them the subgeneric title *Nanger*, remarking that the group is replaced in South Africa by *Antidorcas*. Although I am only acquainted with the normal pedal glands of *G. granti*, I am unable to find in *G. sæmmeringii* and *G. dama* any justification for the view that they lessen the differences between the typical gazelles and *Antidorcas*, or that they represent the latter in north and east Africa more nearly than the other gazelles of that area represent it.

In the same Catalogue another subgenus of gazelles is admitted under the name *Procapra*, comprising the three central Asiatic gazelles *picticaudata*, *przewalskii*, and *gutturosa*, none of which is known to me apart from dried skins and skulls.

Procapra was established by Hodgson for the reception of *picticaudata*, which, according to his description, differs from other gazelles in having no preorbital, inguinal, or carpal glands; no trace of moist rhinarium, and the interdigital fossæ, described in one place as "pores," small. Moreover, on the positive side it possesses a large postcornual sinus, by which is meant apparently a gland behind the horns analogous to that of *Rupicapra* and *Oreamnos*. Admitting the truth of these observations, and I do not see on what grounds they are to be disputed, *picticaudata* must be recognized as generically distinct from *Gazella*, and *przewalskii*, which at least resembles it in the absence of preorbital, inguinal, and carpal glands, must be associated with it—at all events, provisionally. The species named *gutturosa*, on the other hand, resembles the typical gazelles in having preorbital, carpal, and inguinal glands, the first two being small and the last-mentioned large. Clearly, therefore, it must be severed from *picticaudata* and *przewalskii*, for which the name *Procapra* must be retained. But, according to Pallas, *gutturosa* possesses a preputial glandular sack, recalling that of *Moschus*, *Nototragus*, and *Sus*. In this respect it differs, so far as is known, from all the species of *Gazella*. I propose, therefore, to dismember *gutturosa* from *Gazella* under the generic title *Prodorcas*.

Genus ANTIDORCAS, Sund.

Antidorcas marsupialis, Zimm. (p. 893).

Several fresh examples of this species confirm in every

respect the constancy of the characters established in 1910, showing that, so far as the cutaneous glands are concerned, the genus *Antidorcas* differs from *Gazella* in the absence of inguinal and carpal glands and the presence of the great dorsal gland.

I may add that the rhinarium resembles that of *Gazella* in consisting of a small irregularly pentagonal area on the narial septum, and that the penis is also like that of *Gazella*, the urethral canal projecting a short way beyond the tip of the slightly swollen glans (fig. 1, E).

GENUS ANTILOPE, Pall.

Antilope cervicapra, Linn. (p. 894).

My observations upon the cutaneous glands of this antelope were based in 1910 upon two dried skins. Since that date I have seen several fresh specimens, confirming in all respects the characters previously established as distinguishing the genus *Antilope* from *Gazella*. Two other differences are, however, supplied by the rhinarium and the penis. The *rhinarium* (fig. 1, K, L) is considerably better developed, and therefore less specialised than in *Gazella* and *Antidorcas*. Not only is it broader between the nostrils, but it is extended along their upper border nearly as far back as their posterior notch.

In the *penis*, figured by Lönnberg in 1904, the urethral prolongation is longer and thicker than in *Gazella* and *Antidorcas* (fig. 1, A).

GENUS LITHOCRANIUS, Kohl.

Lithocranius walleri, Brooke (p. 896).

I am indebted to the late Mr. F. C. Selous for the fore and hind feet and the skin of the inguinal area of this species from British East Africa. These show that the foot I examined and described in 1910 was, as suggested, distorted with respect to the glandular interdigital space. This space (fig. 1, F) differs from that of *Gazella*, *Antidorcas*, and *Antilope* in that it gradually deepens from its upper (or proximal) to its lower (or distal) end, where the thick interungual fold curves forward. In other words, the skin of the front of the pastern above the depression passes imperceptibly into the latter by a gradual inclination, without showing a sign of the abrupt descent seen in the other genera. The pedal gland recalls that of *Rupicapra*.

There are two pairs of *mammæ*, but no inguinal glands.

By their external characters, dealt with in this paper, and by their horns the genera of Antilopinae here admitted may be briefly diagnosed as follows :—

Genus GAZELLA, Licht.

Preorbital, inguinal, carpal, and pedal glands present, the pedal glands in the form of long and deep interdigital clefts of even depth throughout; rhinarium a small irregularly pentagonal moist area on the narial septum, and not, or only to a very small extent, bordering the nostrils above; urethral canal usually only surpassing the glans penis to a small extent; horns in males with concavo-convex, usually sigmoid, curvature.

Type, *G. subgutturosa*.

Distribution. From Central and South-western Asia into India and North and East Africa.

Far too many species of this genus appear to me to be admitted by Lydekker in the British Museum Catalogue.

Genus PRODORCAS, nov.

Distinguishable from *Gazella* by the presence of a preputial gland and a shorter tail, the structure of the pedal glands being unknown.

Type, *P. gutturosa*, Pall.

Distribution. Mongolia and Northern China.

Genus ANTILOPE, Pallas.

Distinguishable from *Gazella* by the nakedness of the integumental web tying the hoofs together, by the larger rhinarium which borders the nostrils above, by the much longer and thicker elongation of the urethral canal of the glans penis, and by the spirally twisted horns.

Type, *A. cervicapra*.

Distribution. India.

Genus ANTIDORCAS, Sund.

Distinguishable from *Gazella* by the absence of inguinal and carpal glands and by the presence of a large distensible glandular area on the back, which is peculiar to the genus.

Type, *A. marsupialis*, Zimm.

Distribution. Africa south of the Zambesi.

Genus LITHOCRANIUS, Kohl.

Distinguishable from *Gazella* by the structure of the pedal glands, the floor of which gradually slopes downwards from the front of the fetlock, the cleft being deepest at its lower end, where it is walled in by the heel-tie; also by the absence of inguinal glands and the presence of four mammæ.

Type, *L. walleri*.

Distribution. British East Africa and Somaliland.

Genus PROCAPRA, Hodgson.

Distinguishable from *Gazella* by the absence of the pre-orbital, inguinal, and carpal glands, the presence of a gland behind the horns, the reduced size of the pedal glands which apparently have a pore-like orifice, as in *Ovis* and *Nemorhedus*, and, it is stated, by the rhinarium being overgrown with hair.

Type, *P. picticaudata*, Hodgs.

Distribution. Mongolia, China, Tibet.

Subfamily RUPICAPRINÆ.

Genus RUPICAPRA, Blainv.

Rupicapra rupicapra, Linn. (p. 848).

Several examples of the typical race of this species from the Tyrol have enabled me to verify, and in the case of some characters to extend, my observations, which in 1910 were based upon the carcasses of two newly born kids and upon adult specimens living in the Zoological Gardens.

Preorbital and *inguinal glands* are absent and the structure of the *pedal glands* is constant, the floor of the depression slopes gradually downwards from the front of the fetlock to the heel-tie, where the integument is folded forwards and upwards to form a ridge constituting the distal well of the depression. The walls of the depression are covered with soft, short, silky hair. Elsewhere the hair of the foot is long and coarse, and it is noticeable that the space between the hoofs and the heel-tie itself are covered with long hair. In this character the feet of *Rupicapra* differ from those of other genera of Rupicaprines. Even in *Oreamnos*, where the greater part of the interdigital cleft is hairy, the heel-tie at least is naked*.

* My figure of the foot of the newly born chamois shows the point of the heel-tie to be naked. I am, unfortunately, unable to verify the accuracy of the drawing in that respect.

In 1910 I figured and described the *postcornual gland* of the male example then living in the Zoological Gardens when at their maximum of development, and a figure of the head of a female sketched on the same day was added to show the absence of the swelling. But in an adult female that died on Dec. 4th, 1912, I discovered the gland to be much better developed than would be expected from looking at the living animal, in which it is covered with the hair of the parietal region. The glandular area is superficially like that of the male, consisting of a subcircular area of skin marked with grooves. In section it is seen to be composed of thickened skin thrown from front to back into four folds, making ridges separated by valleys, the ridges gradually increasing in height from the base of the horn posteriorly.

It may be remembered that I described this gland in the adult female in 1910 as consisting of a crescentic groove behind the horn on each side, this description being taken from the historic preparation in the Museum of the Royal College of Surgeons. I have no doubt that this preparation was made from a female that died during the period of inactivity of the gland, and that the difference between this specimen and the one I examined, which died in December, is purely a question of seasonal development*.

The *rhinarium* (fig. 2, A, B) is small. It borders the nostril above as a narrow band, and it reaches inferiorly to the edge of the upper lip as a narrow vertically grooved philtrum; but beneath the nostrils it only extends a short distance on each side of the middle line, the rest of the lower rim of the nostril being formed by hairy skin.

The extremity of the *penis* (fig. 2, F) is slightly depressed, and the urethral canal is prolonged beyond the extremity as a pointed process which is a little longer than that of *Nemorhedus*, but shorter than that of *Budorcas* described below. But in the sketch published by Gerhardt in 1906 the process is at least as long as in *Budorcas*.

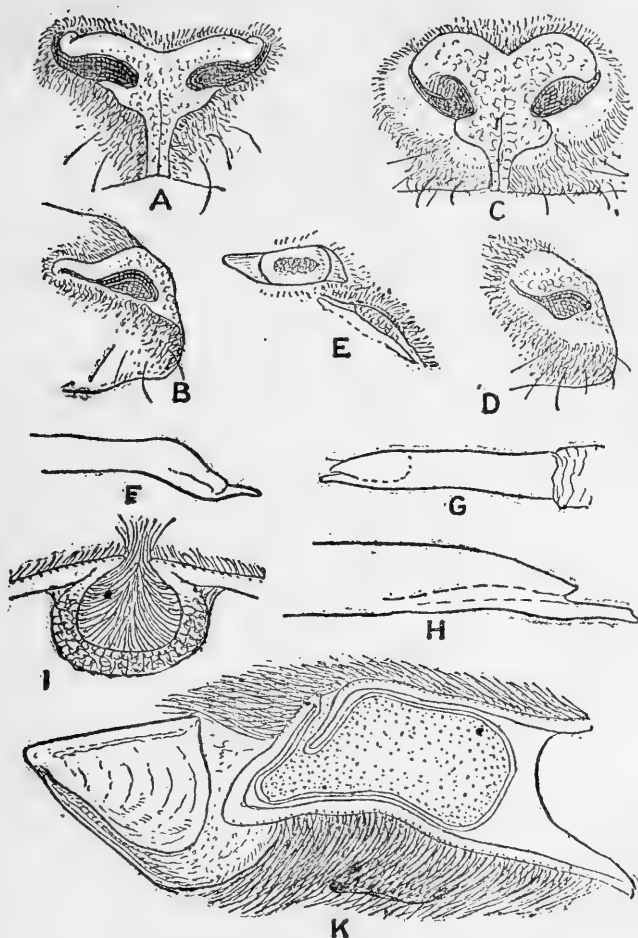
Genus CAPRICORNIS, Ogilb.

Capricornis sumatraensis jamrachi, Poc. (p. 855).

In 1910 I gave a brief account of the superficial appearance of the pedal and preorbital glands of an example of this

* It appears to me to be probable that the "postcornual sinus" described by Hodgson as present in *Procapra picticaudata* resembles in structure the postcornual gland of the female *Rupicapra* when it is in the stage of a crescentic groove. It is detectable in the newly born young of *Rupicapra* in this condition.

Fig. 2.



- A. Rhinarium of *Rupicapra rupicapra* from the front, $\times \frac{1}{3}$.
- B. The same from the side.
- C. The same of *Nemorhedus goral* from the front, $\times \frac{1}{3}$.
- D. The same from the side.
- E. The eye and preorbital gland of *Nemorhedus goral*, the gland in section showing the thickened integument overgrown with hairs, holding secretion at their bases.
- F. Extremity of penis of *Rupicapra rupicapra*.
- G. The same of *Nemorhedus goral*.
- H. The same of *Budorcas taxicolor*.
- I. Section of preorbital gland of *Capricornis thar*.
- K. Section of fore foot of the same, showing the large interdigital gland with its small orifice.

race, named *C. thar jamrachi*, which was then living in the Society's Gardens. The death of the animal in July 1913 enabled me to make a detailed examination of these glands.

The *preorbital gland* (fig. 2, I) consists of a comparatively deep, thick-walled, nearly spherical sack, the cavity of which is absolutely packed with long hairs, growing nearly vertically from its walls and protruding as a tuft from the small, circular, non-valvular orifice.

The *pedal glands* (fig. 2, K), alike on the front and hind legs, open by a small circular orifice on the front of the pastern at the summit of the interdigital cleft exactly as in *Ovis* and *Nemorhedus*, and, as in these genera, the orifice leads into a well-defined cylindrical tube or duct. But, whereas in *Ovis* and *Nemorhedus* this duct gradually passes into a comparatively small saccular portion of the gland bent upon the duct at an acute angle, in *Capricornis* the duct communicates abruptly with an immense saccular gland which occupies the entire space, bounded laterally by the bones of the feet and above and below by the anterior and posterior integument of the pastern. Inferiorly the sack reaches into the angle formed by the fold of integument constituting the heel-tie, and above it extends almost up to a point on a level with the upper edge of the false hoofs. The cavity of the sack was sparsely hairy and filled with brownish-yellow secretion.

So closely are the walls of the glandular sack applied to the integument of the pastern, that I am convinced the explanation of my failure to detect the gland in the dried skin of *C. argyrochætes*, mentioned on p. 855 of my previous paper, lies in the occurrence of a similar condition in that species. Hence the idea I then provisionally entertained, that possibly that species has no pedal glands, may be finally dismissed.

I am unable to find any justification for Lydekker's opinion that the various forms of *Capricornis* should be referred to two species, *C. sumatraensis*, comprising nine subspecies ranging from Kashmir to Sumatra and an unknown number from China, and *C. argyrochætes* from Kansu and Szechuan in China. The latter does not differ so much from some of the subspecies of *C. sumatraensis* as some of the latter differ from each other. In the present state of our knowledge it appears to me that the only courses open to us are to regard these forms as local races of one species, the course I adopted, or as so many distinct species—a course which I prefer to leave to him who has

the time and leisure to discover and define the characters to which specific rank may be assigned.

Genus *CAPRICORNULUS*, Heude.

Capricornulus crispus, Temm. (p. 855).

Heude separated this species of serow from *Capricornis* as a distinct genus *Capricornulus*, which Lydekker and I adopted as a subgenus. But it appears to me that the discovery of the structure of the pedal glands in *Capricornis* throws a different complexion on the question.

In 1910 I figured and described the pedal glands of *Capricornulus crispus*, and pointed out that they resemble in all respects those of *Næmorhedus*. Moreover, the discovery of the presence of preorbital glands in *Næmorhedus* (cf. *infra*) lessens the differences between that genus and *Capricornis*, and results in the occupation by *C. crispus* of a position intermediate between the two so far as cutaneous glands are concerned, the pedal glands resembling those of *Næmorhedus* and the preorbital glands those of *Capricornis*.

Genus *NÆMORHEDUS*, H. Smith.

In 1910 my examination of material of this genus was limited to dried skins of *N. goral* and *N. raddeanus*. Since that date I have seen a fresh adult male example of the former species, which enables me to amplify and, in one particular, to correct my previous observations.

Næmorhedus goral, Hard. (p. 853).

A male example from Chamba, presented by Major Rodon in 1904, which died Nov. 4th, 1915.

The *preorbital gland* was declared to be absent in this genus by Owen, Hodgson, and Ogilby. That statement, which I accepted, proves to be untrue, strictly speaking, although the gland is so small as to account for its being overlooked on dried skins or even on fresh material. Externally the gland is marked by a very small patch of nearly naked skin covered with dry scurf-like secretion. There is no invagination of the integument, but beneath the patch of bare epidermis, the dermis is thickened and glandular (fig. 2, E). The gland, although relatively smaller, may be compared in its development to that of

Adenota kob or *Hippotragus niger*; but whether it represents a rudimentary or vestigial condition of the pouch-like preorbital gland of *Capricornis* must be left an open question.

The *pedal glands* and the structure of the feet resemble in every respect those of *N. raddeanus*, described and figured on p. 854 of my previous paper. *Inguinal glands*, as noticed in 1910, are absent.

The *rhinarium* (fig. 2, C, D) is large and naked on its upper surface almost as far back as the posterior angle of the nostril, but in the middle line above, the hair grows forwards, forming an angular point. Beneath the nostril laterally there is a comparatively wide area of smooth naked skin. In front the rhinarium extends to the edge of the upper lip as a narrow grooved strip of corrugated integument which expands above to right and left beneath the inner angle of the nostrils, and the expanded portion is flanked on each side by an area of smooth naked skin.

The *penis* (fig. 2, G) is cylindrical, slightly expanded distally, then gradually narrowed to the apex, beyond which the end of the urethral canal is prolonged as a tube for a short distance.

Two points of special interest may be noticed in connection with these observations: namely, the similarity of the penis to that of *Budorcas*, described below, and the presence of the preorbital gland, which serves to link *Nemorhedus* closer with *Capricornis* than was previously supposed to be the case.

Genus BUDORCAS, Hodgson.

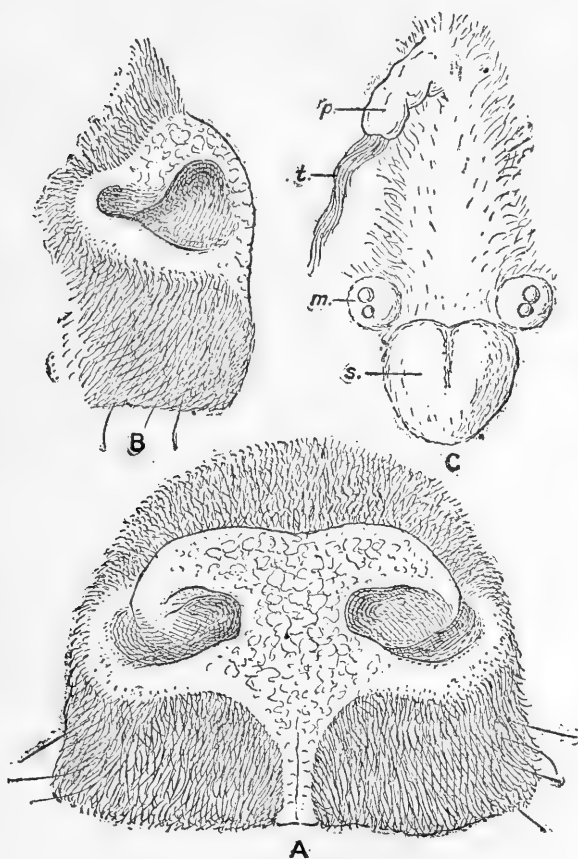
Budorcas taxicolor, Hodgson (p. 856).

The death of a male example of this species from N.W. Bhotan enables me to verify and extend my account of the external characters of this genus published in 1910, and based partly on this example when alive and partly upon a dried skin of *B. taxicolor tibetanus* lent to me by Mr. Gerrard.

The *rhinarium* (fig. 3, A, B) is continued inferiorly to the edge of the upper lip as a narrow mesially grooved strip, which is longer than in *Nemorhedus* owing to the greater depth of the upper lip. Laterally an area of naked skin, narrower than in *Nemorhedus*, is continued with a bold curve beneath the widely expanded nostrils, and curving round their posterior extremities passes into the dorsal

portion of the rhinarium, which is much shorter from before backwards than in *Nemorhedus*, being considerably more overgrown with hair.

Fig. 3.



A. Muzzle of *Budorcas taxicolor* from the front, $\times \frac{1}{2}$.

B. The same from the side.

C. Genital area of *Budorcas taxicolor*. *p.*, pendulous extremity of penis; *t.*, long tuft of hair protruding from the prepuce; *m.*, mammary arising from glandular elevation; *s.*, scrotum.

The feet resemble in essential particulars those of the dried example figured in 1910 (p. 852) and described (p. 856), except that on the fore foot there is no trace of the

transverse ridge of integument just where the hair of the pastern ceases in the interungual space. There is no trace of definite pedal gland, although the hair at the bottom of the interdigital depression in front is stuck together with secretion, indicating activity of the skin at that spot. The hind foot is like the front foot.

There is no trace of *preorbital gland* or of *inguinal glands* in the ordinary sense of that term; but the two mammæ (fig. 3, C, *m.*) on each side, set as far out from the middle line as the outer edge of the scrotum, are close together, one in front of the other, in the centre of a distinct swelling like a small udder. When the skin is cut away, this swelling is seen to be caused by a blackish glandular mass like a small bunch of grapes, and blackish secretion could be squeezed through a single pore on the posterior teat with the use of considerable pressure. This unusual condition of the mammary gland in the male is worth putting on record, although, pending the examination of other specimens of *Budorcas*, it must be regarded, I think, as pathological in one individual.

The *penis* (fig. 3, C, *p.*) is provided with a pendulous prepuce, three inches long, rising from the abdomen six inches in front of the scrotum. Just within the orifice of the prepuce the skin is highly glandular and overgrown with long hairs, which protrude from the aperture to form a tuft three or four inches long. The *glans penis* (fig. 2, H) is apically attenuated and provided with a straight, moderately stout, urethral prolongation projecting some little way beyond the tip of the glans. Except for the greater elongation of the free portion of the urethral canal, the glans penis is very like that of *Næmorhedus*.

One of the chief interests connected with *Budorcas* is involved in the claim that the genus is related to *Ovibos*, whose uncertain position in the Bovidæ was expressed by Lönnberg's ascription of it to a special subfamily Ovibovinae (Proc. Zool. Soc. 1900, pp. 142-167). Judging from the characters dealt with in this paper it does not appear to me that the claim of close relationship between the two forms can be maintained, and I am disposed to regard the resemblances between them in horn-growth, robustness of build, etc., as independently acquired. The differences between them may be tabulated as follows. For most of the characters relating to *Ovibos* I am indebted to Lönnberg's paper:—

Budorcas, ad. ♂.

Rhinarium well developed, about 14 mm. deep above the nostrils, 26 mm. wide between them, and extended beneath them as a naked strip of skin and passing inferiorly to the edge of the upper lip as a mesially grooved band (*philtrum*) about 7 mm. wide.

Preorbital gland absent.

Hoofs narrower, more pointed in front, integument between them naked.

Mammæ 4, the anterior and posterior on each side almost in contact, but very widely separated from those of the opposite side, the four together arranged in a transverse oblong about five times as wide as long.

Prepuce distally pendulous, distal portion of its cavity not provided with longitudinal ridges, but thickly beset with coarse long hairs protruding at all seasons some 4 inches from the orifice as a long tuft.

Glans penis markedly attenuated at the apex, the urethral canal prolonged for a considerable distance beyond the tip.

Ovibos, ad. ♂.

Rhinarium greatly reduced, about 8 mm. deep above the nostrils and only a little more between them, not extending beneath them and not continued inferiorly to the edge of the upper lip.

Preorbital gland present, invaginated.

Hoofs broad, wide in front, integument between them thickly hairy except for the naked heel-tie.

Mammæ 4, arranged so as to form the normal four-sided figure, which is only a little wider than long, the anterior being separated from the posterior on each side by a considerable space.

Prepuce distally pendulous, distal portion of its cavity provided with longitudinal folds and clothed with fine hairs only in the winter, but these do not form a long protruding tuft.

Glans penis blunt at the end, the urethral canal not extending beyond its tip.

But although the differences above tabulated exclude the idea of relationship between *Budorcas* and *Ovibos*, sufficiently intimate to warrant the removal of *Budorcas* from the Rupicaprinæ, as now understood, and its association with *Ovibos* in a special subfamily, they by no means justify the conviction that *Ovibos* is not a specialised Rupicaprine. The description, for example, of the preorbital gland applies to that of *Capricornis* or *Capricornulus*, and the termination of the urethral canal in *Næmorhedus* is nearly intermediate in development between those of *Budorcas* and *Ovibos*; the arrangement of the mammæ is normal for the Ruminantia, as a whole, including the typical Rupicaprinæ; the structure of the feet may be easily derived in imagination from that of *Oreamnos* or even of *Næmorhedus*, in which the gland has reached the retort-like stage, which in the Caprinæ precedes its total suppression, as attested by *Ovis* and *Capra*, and the reduction of the rhinarium in *Ovibos* is foreshadowed

in *Rupicapra*, except for the total suppression of the *philtrum*. In this respect *Ovibos* is highly specialised and unique, so far as its possible allies are concerned.

On the evidence before me, I consider that if the *Ovibovinae* be maintained as a special subfamily of *Bovidae*, the *Rupicaprinae*, as at present understood, should be split up into three subfamilies, the *Rupicaprinae* for *Rupicapra* and *Oreamnos*, the *Nemorhedinae* for *Nemorhedus*, *Capricornulus*, and *Capricornis*, and the *Budorcinae* for *Budorcas*. But if the conservative course of maintaining the *Rupicaprinae* in its recognised comprehensive sense be followed, then *Ovibos* should, I think, be one of the genera of this somewhat heterogeneous assemblage.

Subfamily *CAPRINÆ*.

Genus *Ovis*, Linn.

Ovis musimon, Schr., and *O. vignei*, Blyth (pp. 859-861).

Since 1910 I have examined representatives of the two species previously recorded, namely *Ovis vignei* and *O. musimon*, without finding anything to add or alterations to make to my previous description of the cutaneous glands, except to remark that in the case of *O. musimon* the naked condition of the interungual integument noticed in one specimen is quite exceptional, and that as a very general rule that species and *O. vignei* are alike with respect to the hairiness of the area in question. Possibly the variation noticed is seasonal, as appears to be the case in *Ammotragus lervia*.

The *rhinarium* of *O. vignei* is quite characteristic of the genus. It extends as a narrow bar above the nostrils almost back to their posterior termination, the internarial septum is narrow, the area beneath the septum is a little expanded, and a narrow *philtrum* cleaves the upper lip, but there is no naked area of skin bordering the nostrils below.

The *penis* of *O. vignei* (fig. 4, D), as in *O. aries*, ends in a blunt gland-like enlargement, bent downwards distally. From its underside the very long filiform termination of the urethral canal arises, and passes forward on the left side of the glandular thickening.

Genus *Pseudois*, Hodgson.

Pseudois nayaur, Hodgs. (p. 863).

Specimens examined since 1910 confirm in every respect

the constancy of the characters upon which I separated this species from *Ovis*—namely, the suppression of the preorbital, inguinal, and pedal glands.

The *rhinarium* (fig. 4, F, G) resembles in a general way that of *Ovis vignei*, but the nostrils are more dilatable and the “philtrum” less well defined, hardly a trace of it remaining. In one specimen the hairs of the upper lip are only separated by a very narrow parting, which is completely overlapped and concealed by the hairs to the right and left of it.

The naked underside of the tail (fig. 4, H) is marked on each side above the anus with a wide and moderately deep *glandular depression*, corresponding with the subcaudal gland of *Capra*, but smaller.

The glandular portion of the end of the *penis* (fig. 4, B) is longer and straighter than in *Ovis vignei*, but the filiform termination of the urethra is approximately as long as in that species, and much longer than in the following genera. The length of this tube and the absence of strong “Caprine” smell in the male are two points in which *Pseudois* comes nearer *Ovis* than *Capra*. In the suppression of the specialised cutaneous glands *Pseudois* is Caprine and not Ovine.

Genus AMMOTRAGUS, Blyth.

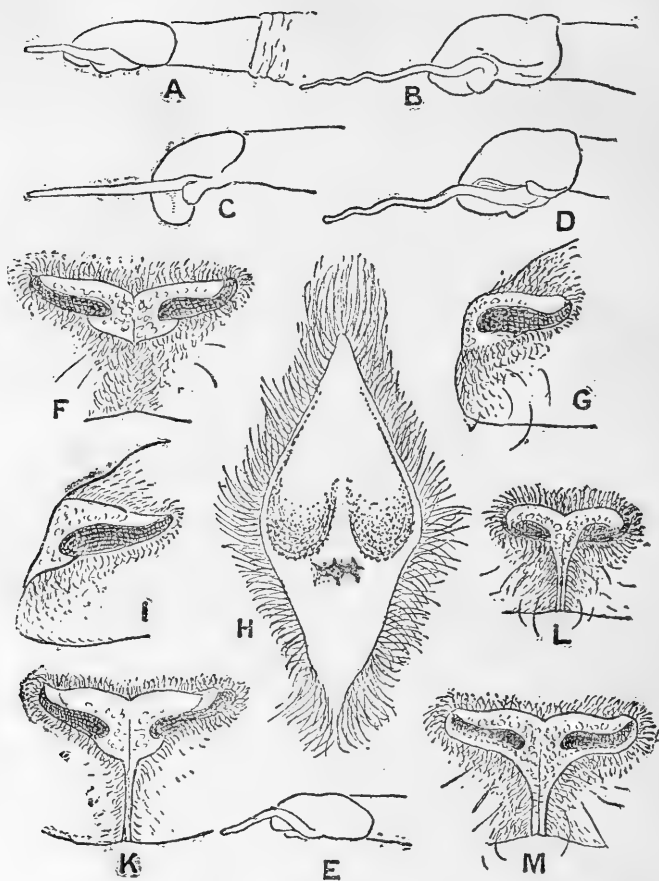
Ammotragus lervia, Pall. (p. 862).

My notes upon this species, published in 1910, were taken from the examination of a living specimen. Several dead examples that have passed through my hands since that date confirm in every respect the statement then made as to the absence of the preorbital, inguinal, and pedal glands.

A peculiarity I drew attention to in 1910—namely, the smoothness of the interdigital depression in the example examined—proves to be inconstant, although the hairs of this area when developed are not so long as in *Ovis* and *Pseudois*. Possibly the variation is seasonal. For instance, in a specimen (♂) that died on Nov. 11th, the interdigital cleft was clothed with short hairs down to the heel-tie, as is normal in the Caprine series. In a second that died on March 5th, the interdigital cleft was naked. A third, which died on Feb. 10th, exhibited a condition intermediate between those of the other two. In the newly born young the space is covered with hair.

The *rhinarium* (fig. 4, M) presents no features of special

Fig. 4.



- A. Extremity of penis of *Hemitragus jemlaicus*.
 B. The same of *Pseudois nayaur*.
 C. The same of *Ammotragus lervia*.
 D. The same of *Ovis vignei*.
 E. The same of *Capra aegagrus*.
 F. Rhinarium of *Pseudois nayaur*, showing absence of philtrum, $\times \frac{1}{3}$.
 G. The same from the side.
 H. Lower side of base of tail of *Pseudois nayaur*, showing the pair of glandular depressions above the anus.
 I. Rhinarium of *Hemitragus jemlaicus* from the side, $\times \frac{1}{3}$.
 K. The same from the front.
 L. The same of *Capra aegagrus*, $\times \frac{1}{3}$.
 M. The same of *Ammotragus lervia*, $\times \frac{1}{3}$.

interest, being typically Ovine or Caprine in structure, with the narrow "philtrum" well developed.

There is a well-marked *subcaudal gland* above the anus as in *Pseudois*.

The gland-like termination of the *penis* (fig. 4, C) is very like that of *Ovis vignei* in shape and curvature, but the filiform termination of the urethra is a little shorter than in that species.

According to Lydekker, the males of this animal are not malodorous (Cat. Ungulates, i. p. 123). That is quite untrue. The males have a very decidedly goatly odour in the breeding season. It is also untrue that the typical race of this species is distinguished by "an indistinct median face stripe." A pair imported from Morocco and exhibited in the Gardens a few years ago showed no trace of such a stripe.

Genus CAPRA, Linn. (p. 864).

I have nothing to add to what I said in 1910 regarding the suppression of the preorbital, pedal, and inguinal glands in various species of this genus.

The *rhinarium* conforms in type to that of *Ovis* and *Ammotragus*, the "philtrum" being better defined than in *Pseudois*. In an example of *C. ægagrus* from Crete, I found the supranarial extension of the rhinarium (fig. 4, L) larger than in most examples of domesticated goats; but this varies to a certain degree in the latter, as also does the width of the naked area of skin beneath the nostrils laterally.

The *subcaudal gland* was a deeper pocket than those observed in *Ammotragus* and *Pseudois*.

The *penis* (fig. 4, E) also is constructed very much as in those genera, and has a well-defined, but rather short, glandular termination, which, on the right side, as in the other genera, curls beneath the tubular filiform termination of the urethra, which is shorter than in *Ovis*, *Ammotragus*, and *Pseudois*.

Genus HEMITRAGUS, Hodgson.

Hemitragus jemlaicus, Hodgs. (p. 866).

Additional specimens confirm my previous statements with regard to the suppression of the preorbital, inguinal, and pedal glands.

Hodgson's assertion that the *rhinarium* (fig. 4, I, K) is larger in *Hemitragus* than in *Capra* is perfectly true. The supranarial extension is considerably deeper, and, similarly,

the extension beneath the inner angles of the nostrils in front is wider.

In the *penis* (fig. 4, A) the glandular termination is more elongate and less bulbous than in *Capra* and the filiform termination of the urethra is shorter. It is the shortest, indeed, that is found within the limits of the Caprinæ.

The *subcaudal gland* is represented externally by a shallow depression above and at the sides of the anus.

Note on the Penis of the Cephalophinæ and Neotraginæ.

In my paper published in the issue of this Journal for June 1918, I regret that I overlooked at the time Lönnberg's descriptions and figures of the penis of *Cephalophus natalensis* and of *Sylvicapra grimmia* (Ark. Zool. Stockholm, (5) v. no. 10, pp. 2-3, figs. 1-2, 1909). He shows that in *C. natalensis* the urethral canal has a very long filiform prolongation resembling that of *Guevei maxwelli* figured by Garrod (P. Z. S. 1877, p. 10, fig. 20), whereas in *S. grimmia* the tubular prolongation is quite short, only overlapping the glans to a small extent. Now, *C. natalensis* is so closely related to *C. dorsalis* as hardly to admit of a doubt as to identity in the structure of the penis in the two species. In that case the penis of *C. dorsalis* I described as being without the tubular urethral prolongation must have been defective, owing to mutilation. Lönnberg's observations show that *Cephalophus* differs from *Sylvicapra* not by the suppression of the urethral prolongation, as I stated, but by its development and length, which affiliate the former genus with *Guevei*.

In the case of the Neotraginæ, it may be recalled that Garrod (*op. cit.* p. 11, fig. 21) described the penis of *Ourebia nigricaudata* as possessing a long slender urethral prolongation considerably overlapping the slender tip of the glans penis, whereas, according to Lönnberg's observations (*op. cit.* p. 4, figs. 3-4), the urethra does not surpass the tip of the glans in *Raphicerus campestris* and *Neotragus livingstonianus*. The penis of the example of *Nototragus melanotis* in which I found the preputial gland agrees with that of *Raphicerus campestris*.

XI.—On Four new Species of the Genus *Demodex*, Owen.
By STANLEY HIRST.

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Demodex soricinus, sp. n.

♀. A small species, the cephalothorax being fairly wide. Body a little more than three times the width of the cephalothorax. Abdomen pointed posteriorly and somewhat longer than cephalothorax + capitulum. Capitulum much wider than long. (The spines on the capitulum cannot be seen in the unique specimen, which lies ventral side uppermost.)

Total length 119 μ .

Host: *Sorex vulgaris*.

Demodex apodemi, sp. n.

♀. A very minute but fairly elongated species. Body about $4\frac{1}{2}$ times as long as the greatest width of the cephalothorax. Abdomen a little less than twice the combined length of cephalothorax and capitulum. Capitulum (at base) wider than the length. Spines on dorsal surface of capitulum well developed, being pointed at the end as in *D. musculi* etc.

Total length 139 μ .

♂. Body from a little more than 4 up to about 5 times as long as width of cephalothorax. Capitulum when fully extended about as long as wide.

Male sexual aperture situated above interval between second and third pairs of legs. Penis fairly long and slender.

Host: *Apodemus sylvaticus*.

Demodex longior, sp. n.

♀. An elongated species of comparatively large size, resembling *D. canis* in many respects. Body sometimes nearly nine times as long as the width of the cephalothorax. Abdomen about $2\frac{2}{3}$ times the combined length of cephalothorax and capitulum. Capitulum wider than long; the spines on its dorsal surface are short and somewhat curved.

Total length 280 μ .

♂. Abdomen about twice as long as the cephalothorax + capitulum. Body more than 6 times as long as the cephalo-

thoracic width. Male sexual orifice situated above the interval between the legs of the first and second pairs.

Note.—In one male specimen the tracheal tubes leading from the capitulum are quite distinct; each is at first double, but afterwards fuses to form a single wide lateral main trunk.

Host : *Apodemus sylvaticus*.

Demodex nanus, sp. n.

♀. A minute species very like that present in *Sorex vulgaris castaneus*. Length varying from less than 3 up to slightly more than $3\frac{1}{2}$ times the width of the cephalothorax. Abdomen considerably shorter than combined length of cephalothorax and capitulum. Capitulum usually much wider than long; the spines on its surface apparently obsolete or absent.

Total length 87–102 μ .

Host : the black rat (*Rattus rattus*), a number of specimens collected by the author from a freshly killed rat.

Note.—Hahn has already described a species of *Demodex* (*D. ratti*) from a house-rat said to be *Mus rattus*. I have not been able to consult his original description, which is referred to by Gmeiner. The latter says the species is like that of the dog. From this one would infer that it was an elongated form of comparatively considerable size, similar to that found in *Rattus norvegicus*.

It is probable, indeed, that the rat from which Hahn's specimens were taken was really *Rattus norvegicus*, the brown or Norwegian rat (syn. *Mus decumanus*). It is, of course, possible that two species occur in *Rattus rattus*, as is certainly the case in *Apodemus sylvaticus*.

XII.—*New Species of Gerbillus and Taterillus.*

By OLDFIELD THOMAS.

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Gerbillus allenbyi, sp. n.

A small species, with short feet and tail; probably allied to *G. agag*.

General colour much more mouse-grey than the usual tone of gerbils, markedly greyer than *G. gerbillus*; head, shoulders, and most of the upper surface near "cinnamon-buff," but

the middle dorsal area greyer, though this difference may be less marked in older specimens. Under surface less absolutely pure white than usual, the hairs, especially in the inguinal region, with a slight tinge of buffy. Postorbital light patches present, but not very sharply defined; below them on each side, between eye and ear, there is a distinct patch of grey hairs. Ears with proectote buffy, the rest whitish; post-auricular white patch sharply defined. Hands and feet white, but a slight tendency to buffy appears on the wrists; soles all hairy except for a small round patch on the heel. Tail not proportionally long; dull buffy, little lighter below; its terminal dark crest inconspicuous.

Skull of the general build of that of *G. gerbillus*, but the bullæ smaller. Supraorbital beads little developed.

Dimensions of the type (measured in flesh) :—

Head and body 70 mm.; tail 95; hind foot 24; ear 9.

Skull: greatest length 26.2; condylo-incisive length 23; zygomatic breadth 14.5; nasals 9.6; interorbital breadth 5.2; breadth of brain-case 13.3; zygomatic plate 3.9; palatal foramina, anterior 4.4, posterior 2.2; greatest horizontal diagonal diameter of bulla 9.2; breadth of bulla at right angles to last, exclusive of meatus, 5.7; upper molar series 4.

Hab. Coast region of Palestine. Type from Rehobot, near Jaffa.

Type. Young adult male. B.M. no. 14.5.29.5. Original number 8. Collected 3rd February, 1914, by T. Aharoni. Presented by the Hon. N. Charles Rothschild.

This is evidently the species which Nehring* assigned to *G. longicaudus*, Wagn. But Wagner's animal, which I have seen in Munich, was from Egypt, and was clearly referable to *G. gerbillus*, as has been shown by Anderson and de Winton.

The Palestine gerbil seems to be related to *G. agag*, Thos., but is readily distinguishable by its less bright colour, greyer back, and the greyish patches between eye and ear.

I have named it in honour of the general to whose forces the country where it occurs owes release from the barbarian domination under which it has suffered for so many centuries.

Gerbillus acticola, sp. n.

Near *G. pygargus*, but the bullæ larger.

Size and colour as in *G. pygargus*, of the same light desert-colour—quite unlike that of *G. dunni* of Central

* SB. Ges. Fr. Berl. 1901, p. 173.

Somaliland. Compared with a series from Shendy, the ground-colour is warmer, being near "warm buff" in *pygargus*, while it is "pinkish cinnamon" in *acticola*; but the variation in the colour of these desert-animals is so great that not much stress can be laid upon it. Sides lighter, line of demarcation high up. Postorbital and postauricular white patches well marked. Fore limbs wholly, hind limbs mostly white. Hind soles with a nearly naked stripe running along the inner side almost to the base of the hallux. Tail buffy above, white below; the terminal crest inconspicuous, brown.

Skull of the same stoutly built elongated form as in *pygargus*, the supraorbital beads similarly strongly developed. Bullæ of similar shape, but decidedly larger than in any of the considerable series available of *pygargus* and *pyramidum*.

Dimensions of the type (measured in the flesh):—

Head and body 118 mm.; tail 144; hind foot 29; ear 15.

Skull: greatest median length 32.5; greatest diagonal length 32; condylo-incisive length 28.5; zygomatic breadth 17.4; nasals 12.7; interorbital breadth 6.6; breadth of brain-case 14.5; breadth between meatal edges 16.3; zygomatic plate 4.7; palatal foramina, anterior 5.4, posterior 3; bullæ, horizontal diagonal length 12; breadth at right angles to last, excluding meatus, 7; greatest diameter in any direction 12.7; upper molar series 4.1.

Hab. Coast region of N. Somali. Type from Berbera, other specimens from Bulhar.

Type. Adult female. B.M. no. 7.11.5.4. Original number 32. Collected 30th July, 1905, and presented by Dr. R. E. Drake Brockman. Nine specimens.

This Somali representative of *G. pygargus*, distinguished by its larger bullæ, is the species mentioned on p. 119 of Dr. Drake Brockman's 'Mammals of Somaliland' (1910) as the Coast Gerbil, a title I have Latinized as above.

Gerbillus vallinus, sp. n.

A *Gerbillus* with an unusual amount of the soles naked and with very large bullæ.

Size about as in *G. pæba*. Fur long and loose. General colour strong sandy buffy, near "cinnamon-buff," not so inclined to russet as in *G. pæba*. Line of demarcation on sides not very sharply defined. Lighter postorbital and postauricular markings scarcely perceptible. Ears short, their

proectote buffy like the general colour. Fore limbs wholly in the white area, without any darker colour on their front surface. Soles less haired than in other members of *Gerbillus*, the naked area extending from the heel along the middle of the sole to the level of the base of the hallux, but the region of the pads is closely and profusely hairy, as usual in the genus. Tail at base pale buffy above, whitish below—its terminal portion lost in the type.

Skull remarkable for the great size of the bullæ, which tend to recall those of *Desmodillus* and far exceed those of any other member of this genus. The posterior breadth of the skull is therefore unusually great. Muzzle slender. Supra-orbital beads present. Zygomatic plate more projected forward than in most species of *Gerbillus*, and almost approaching the projection characteristic of *Taterillus*; the same is the case in *G. pæba*. Palatal foramina, both anterior and posterior, large and well open. Bullæ greatly swollen, the anterior edge of the meatus also inflated; a well-marked vacuity just beneath the opening of the meatus.

Dimensions of the type (measured in the flesh):—

Head and body 92 mm.; tail (60+); hind foot 30; ear 15.

Skull: greatest median length 29; greatest diagonal length 30; condylo-incisive length 27; zygomatic breadth 16; nasals 11·2; interorbital breadth 6; breadth of brain-case 14·3; breadth between outer edges of meatal inflations 16·8; zygomatic plate 4·8; palatal foramina, anterior 5·2, posterior 2·5; greatest horizontal diagonal diameter of bulla 10·7; greatest diameter in any direction 12·2; upper molar series 4·2.

Hab. Bushman-land. Type from Tuin, near Kenhart, Hartebeest River, near 29° S., 21° E.

Type. Adult male. B.M. no. 12. 1. 11. 2. Presented alive by Maj. H. A. P. Littledale to the Zoological Society, by whom it was transferred on death to the National Collection.

This well-marked species is readily distinguishable by its greatly enlarged bullæ, which tend to approach in size those of *Desmodillus auricularis*, obtained in the same region by Major Littledale. The hind feet of this animal are also more naked than in other members of *Gerbillus*, but have, however, the characteristic distal cushion which distinguishes the genus from *Dipodillus*.

Taterillus gyas, sp. n.

A *Taterillus* with decidedly larger skull than any other.

Size rather, but not conspicuously, larger than in *T. emini*. General colour above strong and dark, near "cinnamon," or even approaching "tawny"; sides cinnamon-buff. Ears rather large. Hands and feet white; soles quite without any trace of the usual transverse band of fur. Tail long, its basal half brownish above, dull buffy below; terminal tuft well developed.

Skull conspicuously larger and more heavily built than in any known *Taterillus*. Interorbital region rather more parallel-sided than usual, the supraorbital ridges strongly developed. Posterior palatal foramina extending from the level of the front root of m^1 to the middle of m^2 . Bullæ of average proportional size.

Dimensions of type (measured in flesh):—

Head and body 127 mm.; tail (damaged in type, 175 mm. in another specimen of about the same size); hind foot 34; ear 21.

Skull: greatest length 39; condylo-incisive length 35; zygomatic breadth 19·5; nasals 15·6; interorbital breadth 7·3; breadth of brain-case 15·8; zygomatic plate 7·3; palatal foramina, anterior 7·2, posterior 4·6; horizontal diagonal diameter of bulla 10·2; upper molar series 5·5.

Hab. Kamisa, Dinder R., Sudan.

Type. Adult female. B.M. no. 14. 3. 8. 24. Original number 55. Collected 26th December, 1913, by Willoughby P. Lowe, and presented by Abel Chapman. Two adult and six young specimens examined.

This *Taterillus* is remarkable for its large size and the complete absence of the hairy band across the soles. It thus considerably resembles the members of the genus *Taterona*. But its elongate posterior palatine foramina show that its place really is in this genus, all the more that *T. gracilis* proves to be variable in the development of the same hairy band. In that species the band is commonly absent, fairly often slightly or partially developed, and occasionally fully developed, all extremes occurring in any one locality. This species ranges eastwards from the Gambia to Upper Nigeria, where it occurs side by side with *T. nigerie* on the Bauchi Plateau. The latter was first described from a single specimen, but about a score of gerbils have been more recently sent by Mr. Fox, and were all supposed to be of the same species as the first. I now find, however, that they

are mostly referable to *T. gracilis*, only four belonging to *T. nigeriæ*, which may be distinguished by its larger size, longer anterior palatine foramina, and uniformly longer feet, and these in all four examples have well-developed sole-bands.

XIII.—*A new Duiker from Zanzibar.*

By OLDFIELD THOMAS.

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THE British Museum has received from Dr. W. M. Aders, Government Biologist at Zanzibar, native skins of three local Ungulates, two antelopes and a *Potamochoerus*. One of the former is that of a *Nesotragus moschatus*, but the other represents a duiker quite distinct from any species hitherto described.

In honour of its donor, to whom the Museum is indebted for many Zanzibar mammals, it may be called

Cephalophus adersi, sp. n.

Allied to *C. weynsi**, but with whitish bands across thighs and a white tufted tail.

Size and general characters about as in *C. weynsi* of the Congo. Line along nape with reversed fur, as in that species. General colour of withers and nape dark brown (near mummy-brown), which gradually becomes more rufous (darker than "avellaneous") on the shoulders and flanks, and posteriorly on the rump passes into deep rich chestnut-rufous ("mahogany-red" where richest). Under surface whitish, not sharply defined laterally, the hairs pale drabby at base, whiter terminally; a mesial rufous patch on the chest. Fore limbs with the avellaneous rufous of the shoulders passing down without interruption, but on the hind-quarters there is a broad whitish band running across the outer side of the hips and separating the chestnut-red of the rump from the rather paler red of the legs; this band is more or less rufous white where it commences on the sides above the inguinal glands, but becomes nearly pure white posteriorly, where it

* Figured and described, Ann. Mus. Congo, ii. p. 15, pl. vi. (1901).

contrasts prominently with the mahogany-red rump. Fore and hind feet deep rufous speckled with white, but how far these white specklings may be an individual abnormality I have no means of judging. Tail, without tuft, about 2 inches in length, the tuft well marked, its hairs rather more than an inch long, wholly white, though there is a narrow rufous line running along the top of the tail basally.

Middle of neck to rump about 24 inches.

Hab. Zanzibar.

Type. Native skin. B.M. no. 18. 5. 25. 1. Presented and collected by Dr. W. M. Aders.

By its reversed nape-hairs and general type of coloration, with brown fore back and rufous rump, this striking duiker shows relationship to *C. weynsi*, but it is at once distinguished by the whitish bands which run across the thighs and show up the brilliant rufous of the rump, and by the wholly white tail-tuft, that of *C. weynsi* being prominently blackish above.

These characters are so marked that, although the specimen is a native skin, without head or hoofs, I feel justified in describing it, but hope Dr. Aders may soon be able to obtain a complete example of so striking an animal, on whose discovery he is to be congratulated.

XIV.—Notes on *Alcides*, *Schönh.* (*Curculionidæ*, *Coleoptera*).

By GUY A. K. MARSHALL, D.Sc.

CONSIDERABLE confusion exists in collections with reference to the strikingly marked species of *Alcides* related to *A. delta*, Pasc. Pascoe's original description (Journ. Linn. Soc. Lond., Zool. x. 1870, p. 460) was based on three specimens, from Ceylon, Ceram, and Amboyna respectively; of these he selected the Ceylon specimen as his type, and the other two examples now prove to belong to a quite distinct species. Subsequently he gave a figure of *A. delta* (*ibid.* xi. 1871, pl. ix. fig. 10), but instead of illustrating his type he unfortunately selected a so-called "variety," which turns out to be yet a third species, and was later described by Kirsch under the name of *triangulifer* (Mitt. Mus. Dresd. i. 1875, p. 40). Probably misled by Pascoe's figure, Aurivillius in 1891 (Nouv. Arch. Mus. Paris, (3) iii. p. 218) sunk *triangulifer* as a synonym of *delta*, and thus it stands in Bovie's 'Catalogue of Alcidiinæ' (Wytsman, fasc. 71).

As a matter of fact, *A. delta* differs from both the other forms mentioned above in a very striking character; normally in *Alcides* each tarsal claw is deeply cleft, but in *A. delta* the claws are simple and soldered together at the base. This character is also found in yet another new and allied species, likewise from Ceylon. I have not so far observed it elsewhere in the genus, though Lacordaire mentions its occurrence without citing any species. *A. triangulifer* presents a somewhat intermediate condition, the inner division of the claw being very much reduced.

The following table will serve to discriminate the members of this group, all of which possess a similarly-shaped large patch of silvery-white scales on the side of the meso- and metasternum, and this also occurs in the very differently marked *A. kirschi*, Pasc., from Labuan:—

- | | |
|--|-----------------------------|
| 1 (4). Tarsal claws simple, connate at the base ; sides of prothorax not constricted in front ; genæ of ♂ not produced downwards at the apex. | |
| 2 (3). Transverse impression at base of elytra shallow, base of prothorax not lower than the apex ; apical edge of rostrum produced into a short point in the middle | <i>delta</i> , Pasc. |
| 3 (2). Transverse impression on elytra very deep, base of prothorax distinctly lower than the apex ; apical edge of rostrum shallowly emarginate in the middle. . . | <i>ephippiatus</i> , sp. n. |
| 4 (1). Tarsal claws cleft ; sides of prothorax markedly constricted in front ; genæ of ♂ with a tusk-like downward process at the apex. | |
| 5 (14). Elytra with a large common triangle formed of broad pale stripes enclosing a black triangle ; front tibiæ with an internal tooth placed nearly in the middle. | |
| 6 (9). Peduncle of submentum narrowly oblong (2×1) and shallowly constricted at the extreme base only ; anterior pale stripe on prothorax running transversely upwards along the edge of the granulate area, not covering the post-ocular lobe. | |
| 7 (8). Apical margin of rostrum rounded ; scutellum pointed at apex ; post-humeral stripe on elytra not uniting behind with posterior angle of the pale triangle. | <i>ceramodelta</i> , sp. n. |
| 8 (7). Apical margin of rostrum with a short sharp point in the middle ; scutellum | |

- rounded at apex; post-humeral stripe on elytra uniting broadly with the posterior angle of the triangle *muiri*, sp. n.
- 9 (6). Peduncle of submentum subtriangular, broad at apex and very strongly narrowed behind; prothorax with an ill-defined pale stripe covering the whole postocular lobe and running obliquely backwards on to the disk.
- 10 (11). Shoulders of elytra produced outwardly into a sharp angle; setæ at apex of tibiæ blackish *siamodelta*, sp. n.
- 11 (10). Shoulders of elytra obtuse; setæ at apex of tibiæ reddish.
- 12 (13). Elytra broader, broadest at the shoulders and narrowing gradually behind; ædeagus of ♂ with the median lobe narrowed to a point at the apex; prothorax with an oblique blackish stripe running from the eye almost to the base *triangulifer*, Kirsch.
- 13 (12). Elytra narrower, almost parallel-sided from the shoulders to beyond the middle; ædeagus of ♂ with the median lobe dilated at the apex, its apical margin very broad and sinuate; prothorax with the black mark behind the eye confined to the non-granulate apical area *javanodelta*, sp. n.
- 14 (5). Elytra without any distinct triangular markings, the oblique discal pale stripes diverging from the middle to the shoulders instead of converging towards the scutellum; the internal tooth on the front tibiæ much nearer to the base than to the apex *magicus*, Pasc.

Alcides delta, Pasc.

So far as is known at present the true *A. delta* is confined to the lowlands of Ceylon.

Alcides ephippiatus, sp. n.

♂ ♀. This species has the same general facies and pattern as *A. delta*, as well as the simple and connate claws, but differs as follows:—The pale markings are usually covered with a dark pink or pinkish-brown powdering, and the stripes on the elytra are generally narrower, so that the enclosed black triangle is larger; the infra-humeral stripe is reduced to one-half the length or less; in the V-shaped apical patch the outer arm (on interval 7) is only half as long as the

inner (on interval 3), whereas in *delta* they are equal or nearly so. The rostrum is proportionately much shorter, and the apical edge is shallowly emarginate in the middle. The dorsal outline of the prothorax is much more convex, so that the basal margin is well below the plane of the apical. The elytra are proportionately shorter, the basal transverse impression being much deeper, so that the dorsal outline is strongly convex; intervals 3 and 4 are not so markedly costate at the base, and the scales that form the pale markings are much smaller, most of them being very deeply fringed at the apex.

Length 10–13½ mm., *breadth* 4½–5½ mm.

CEYLON: Dikoya, 4000 ft. (type), and Bogawantalawa, 5000 ft. (*G. Lewis*); Kandy (*E. E. Green*).

The deeply sinuous dorsal outline of this species renders it easily recognizable. It appears to be the mountain representative of *A. delta* in Ceylon.

Alcides siamodelta, sp. n.

♀. Closely resembling Pascoe's figure of *A. triangulifer* (*l. c.*), except that the shoulders of the elytra are produced outwardly into a sharp angle. Other distinctions are:—In *triangulifer* the 7th joint of the funicle is elongate and equal to or longer than the club (4:3–4), in the transverse pale band forming the base of the triangle on the elytra the intervals are distinctly granulate, the apical setæ on the tibiæ are reddish, and the tarsal claws have the inner division unusually short and slender; in *siamodelta* the 7th joint of the funicle is transverse and distinctly shorter than the club (2½:4), the intervals are not granulate in the transverse band of the elytra, the apical setæ on the tibiæ are blackish, and the tarsal claws are normal, the inner division being about three-fourths the length of the outer.

Length 9½–10½, *breadth* (at shoulders) 5¼–6 mm.

FRENCH INDO-CHINA: Laos (type); SIAM.

Alcides triangulifer, Kirsch.

So far as I know at present this insect is confined to the Malay Peninsula, Burma, and the Nicobars. Insects recorded from Borneo under the name of *A. delta* will probably be found to belong to a distinct species.

Alcides javanodelta, sp. n.

♂ ♀. Apart from its narrower form and shorter rostrum,

extremely similar to *A. triangulifer*. In addition to the characters given in the key, the following distinctions have been noted:—The mentum is quite flat (in *triangulifer* it bears a shallow longitudinal impression); the proportions of the 7th funicular joint to the club are $2-2\frac{3}{4} : 3\frac{1}{2}-4$ (in *triangulifer* $4 : 3-4$), and the intermediate tibiæ are simply angulate in the middle internally (in *triangulifer* there is a sharp tooth). But its most striking character is the broad dilatation at the apex of the median lobe of the ædeagus, for in all other species of the group this organ is pointed at its tip, as is usual in the genus.

Length $8\frac{1}{2}-12\frac{1}{2}$ mm., breadth $3\frac{1}{2}-5\frac{1}{2}$ mm.

JAVA.

All the specimens of this group that I have seen from Java belong to this species. There is in the British Museum a single specimen labelled Singapore (*Coll. Atkinson*), but it seems possible that the locality may be erroneous.

Alcides ceramodelta, sp. n.

♂ ♀. While this species agrees with *triangulifer*, as compared with *delta*, in the structural characters mentioned in the key, it differs from it in the pattern of the prothorax, which quite resembles that of *delta* and *ephippiatus*, the general colour being blackish brown, with the usual oblique lateral pale stripe above the coxæ, a transverse subapical pale band running along the anterior edge of the granulate area, and a pale central stripe.

The general form is broader in proportion to its length than in any of the other species. The rostrum is proportionately short and stout, and its apical margin is rounded, with traces of very feeble undulations; the peduncle of the submentum differs from that of all other members of the group (except *A. muiri*) in its more narrowly oblong form. In the antennæ the 7th joint of the funicle is shorter than the club ($3 : 4$)*. The prothorax is very similar in shape to that of *triangulifer*, but the granules are slightly smaller and there is no trace of the shallow median stria. The scutellum is bluntly pointed at its apex, whereas in all the other species it is broadly rounded. The intervals on the elytra are more distinctly granulate than in *delta* and rather less carinate than in *triangulifer*, thus giving the

* By actual measurement; owing to the club being pointed, it appears relatively shorter than it really is.

elytra a somewhat smoother appearance. The legs are markedly shorter than in *triangulifer*, but the tarsal claws are similar, the inner division being much reduced; the median tooth on the middle tibiæ is almost as long as that on the front pair.

Length $12\frac{1}{2}$ –13, breadth $6\frac{1}{2}$ – $6\frac{3}{4}$ mm.

CERAM (type); AMBOINA (A. R. Wallace).

Alcides muiri, sp. n.

♂. Pattern similar to that of *A. delta* and *A. ceramodonta*, except that the post-humeral stripe on the elytra unites broadly with the posterior angle of the pale triangle on each side; the edges of the pale markings rather ill-defined.

Very similar in structure to *A. ceramodonta*, but the elytra distinctly narrower. The rostrum proportionately longer and its dorsal outline less convex than in that species, the length equal to that of the middle dorsal line of the prothorax (4 mm.), whereas in the latter the rostrum is 4 mm. and the prothorax 5 mm.; the apical margin of the rostrum with a short sharp central projection, and the genæ produced downwards. The prothorax with comparatively fine and close granulation, its dorsal front margin rather strongly rounded. Scutellum broadly rounded at the apex. The intervals of the elytra with low granules throughout. The tooth on the middle tibiæ only slightly smaller than that on the front pair, the hind pair distinctly angulate internally, the apical fringe of a chestnut colour; tarsal claws cleft, the inner division very small.

Ædeagus about half the width of that of *A. ceramodonta*; the spiculum fine and hair-like, more slender than in any of the other species, its median width one-third of that of *A. ceramodonta*.

Length 13, breadth 6 mm.

TIMOR-LAUT Is.: Larat (F. Muir).

The following corrections must be made in Bovie's 'Catalogue of the Alcidiinæ' (Wytsman, fasc. 71):—

(*A. wahlbergi*, Chev. 1881 = *humerosus*, Ancy, 1881, nec Har. 1880 = *anceyi*, Bovie, 1908) = *A. olivaceus*, Gerst. 1862.

(*A. curialis*, Pasc. 1883) = *A. transversus*, Walk. 1859.

(*A. parilis*, Pasc. 1882) is the ♂ of *A. indigaceus*, Pasc. 1882.

(*A. rubrirostris*, Pape, 1907) = *A. lameerei*, Faust, 1899.

(*A. trilineatus*, Faust, 1891) = *A. signatus*, Boh. 1836.

A. signatus, Boh., is cited by Bovie (on the authority of Faust) as an African species, but in reality it is Indian; and all the specimens identified by Faust under this name (*cf.* Ann. Soc. Ent. Belg. 1899, p. 415) will almost certainly prove to be *A. arcuatus*, Boh.

A. roelofsi, Lewis, is omitted from Bovie's Catalogue; it was proposed (Ann. & Mag. Nat. Hist. 1879, p. 465) as a new name for *A. albolineatus*, Roel. 1875 (*nec* Boh. 1836), and *A. sexvittatus*, Faust, 1894, falls as a synonym of it.

The genus *Acærus*, Pasc., should not be included in the Alcidiinæ; it belongs to the Hylobiinae, being nearly related to *Paipalesomus*, Schh.

XV.—On the Varieties of the Lizard *Ophiops elegans*, Mén.
By G. A. BOULENGER, F.R.S.

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THIS lizard, the type of the remarkable genus *Ophiops* established by Ménétriés in 1832, the distinguishing feature of which resides in the apparent absence of eyelids*, varies

* "Palpebra inferior nulla, superioris tantummodo rudimenta," Ménétriés.—"Oculi palpebris destituti, capsula oculari instructi," Wiegmann.—"Pas de paupières," Duméril & Bibron.—"Eyelids none," Günther. I have long ago set right this misconception. The only character distinguishing this genus from *Cabrita*, Gray, is the fusion of the lower eyelid with the upper, a state of things conveying the appearance of an absence of the eyelids. What was supposed to be the cornea of the eye in *Ophiops* is the transparent disc of the lower lid, neither more nor less developed than in *Cabrita*. Although united with the upper, the lower eyelid is, however, not absolutely immovable. On touching the transparent disc in an *Ophiops occidentalis* which I had alive, I observed this to be at once lowered, the upper half of the eye being then covered by the granular portion of the lid.

considerably in the lepidosis, more or less according to the districts it inhabits, and has, in consequence, given rise to the establishment of a certain number of species, untenable as such. However, with a large material (I have carefully examined about 350 specimens) it is just possible to draw up definitions justifying the retention of some of these forms, whilst degrading them to a subordinate rank.

The typical *Ophiops elegans* was founded on specimens from Transcaucasia, in which, according to Boettger, the number of scales and plates round the body varies between 34 and 40 *. Those examined by me are from Asia Minor (Angora, Kaisarieh, Albistan, Giaour Dagh).

The varieties which I recognize are four in number. Their characters are contrasted with those of the typical form in the following synopsis, intended to apply to series of specimens :—

- | | |
|---|---------------------------|
| 32 to 41 (usually 34 to 40) scales and plates round middle of body; 7 to 13 (usually 9 to 12) femoral pores on each side; collar distinct only on the sides; occipital small or very small | Forma typica. |
| 28 to 34 scales and plates round middle of body; 8 to 12 (usually 9 to 11) femoral pores on each side; collar distinct only on the sides; occipital small or very small | Var. <i>ehrenbergii</i> . |
| 30 to 37 (usually 31 to 36) scales and plates round middle of body; 8 to 11 (rarely 12) femoral pores on each side; collar often distinct, sometimes free across the throat; occipital rather large, sometimes 2 to 2½ times the width of the interparietal | Var. <i>persicus</i> . |
| 30 to 34 scales and plates round middle of body; 11 or 12 femoral pores on each side; nostril between 3 shields, a single postnasal being present. | Var. <i>mizolepis</i> . |
| 38 to 49 (usually 40 to 46) scales and plates round middle of body; 10 to 16 (usually 11 to 15) femoral pores on each side; collar and gular fold often distinct; occipital small or very small. | Var. <i>schlueteri</i> . |

Var. *ehrenbergii*.

Amystes ehrenbergii, Wieg. Arch. f. Naturg. 1835, ii. p. 1.

As has been pointed out by Boettger, the specimens from Western Asia Minor and the Southern Sporades differ from

* Having counted them in 70 specimens from Angora, I find 16 specimens with 36 scales and plates, 12 with 37, 11 with 38, 8 with 40, 7 with 39, 6 with 35, 6 with 34, 2 with 33, 1 with 32, 1 with 41. 10 femoral pores in 58, 11 in 46, 9 in 22, 12 in 9, 13 in 4, 8 in 1.

the typical form in having larger scales on an average. The same form occurs also in Syria (*Amystes ehrenbergii*, Wiegman.), together with the small-scaled *O. schlueteri*, Boettg.

I count 28 to 34 scales and plates round the middle of the body; the posterior dorsals are sometimes nearly as large as the upper caudals, forming 7 to 10 longitudinal series between the hind limbs. The lower border of the subocular is usually longer than in the typical form, $\frac{1}{3}$ to $\frac{1}{2}$ the length of the upper border, rarely $\frac{1}{4}$.

The specimens examined by me are from Constantinople, Smyrna, Xanthus, Meander Valley, Zebil Bulgar Dag (Cilician Taurus), Lebanon, Mt. Hermon, Mt. Tabor, Samaria, Galilee, Jerusalem.

Var. *persicus*, nov.

The specimens from Persia (Superghan, L. Urmi, Ispahan, Shiraz, Karman) are distinguished by the larger occipital, which may be twice or twice and a half the width of the interparietal, and the more extensive share taken by the subocular in the border of the mouth, agreeing with the var. *ehrenbergii* in the latter respect. The collar is often more distinct, sometimes free across the throat. 30 to 37 scales round the middle of the body, usually 31 to 36. 8 to 11, rarely 12, femoral pores on each side.

Var. *mizolepis*.

Gymnops mizolepis, Stoliczka, Proc. As. Soc. Beng. 1872, p. 124.

Ophiops mizolepis, Blanf. E. Persia, p. 369, pl. xxv, fig. 2.

A single specimen from the low country S.W. of Kalabagh, on the Indus, has been made the type of a distinct species, and even referred to a distinct genus, on account of the presence of a single postnasal instead of two. I have not seen the specimen, stated to have 34 scales and plates round the body and 12 femoral pores on each side, but there is nothing in the description to warrant a separation from *O. elegans*, and I should have felt inclined to regard the presence of one postnasal instead of two as an individual peculiarity, such as I have noticed in the var. *schlueteri* and in *O. occidentalis*, were it not that Blanford has rediscovered the same form at Basra, Mesopotamia, where it is said to occur in abundance, and where the character appears to be fixed*. It is also noteworthy that the only two specimens

* According to Blanford, it occurs as a rare exception in S. Persia:

from Haifa in Palestine examined by Boettger are distinguished from all other Syrian individuals by the same character. In view of the constancy of the single postnasal in individuals from certain localities, I retain *O. mizolepis* under a varietal name, but provisionally only and with some doubts as to its validity.

I have examined two of Blanford's Basra specimens, as well as two recently obtained at the same place by Col. Wall* and one from Amara, Mesopotamia, received from Capt. P. A. Buxton.

Var. *schlueteri*.

Ophiops schlueteri, Boettg. Ber. Senck. Ges. 1879-80, p. 176, pl. iii. fig. 3.

This is the most distinct of the various forms grouped under *O. elegans*, and one might feel inclined to regard it as a valid species. There is, however, an overlap in the numerical character of the scales as compared with the typical form, and no constancy in the other characters pointed out in the original description; so that it is better to treat *O. schlueteri* as a variety, completely connected with the typical form and the var. *ehrenbergii*.

The dorsal scales are small, the posterior always much smaller than the basal caudals; they form 10 to 14 longitudinal series between the hind limbs; 38 to 49 scales and plates round the middle of the body, usually 40 to 46. The femoral pores number 10 to 16 on each side, usually 11 to 15. The temporal scales are usually smaller than in the typical form (50 to 90 instead of 34 to 63, 27 to 50 in the var. *ehrenbergii*). A more or less distinct gular fold; collar usually distinct, but very rarely quite free. The subocular borders the mouth very narrowly, its lower border is rarely more than one-fourth the length of the upper. One specimen has a single postnasal instead of two.

This variety is confined to Palestine (I have examined specimens from Mt. Hermon and Baalbeck) and Cyprus. It should be regarded as, on the whole, the most primitive of the forms included under *O. elegans*.

"In two specimens . . . the lower nasal is joined to the lower postnasal, so that the nasal shields resemble those in *Chondrophiops* [= *Gymnops*] or *Eremias*."

* Preserved in the collection of the Bombay Natural History Society.

XVI.—*Description of a new Lizard of the Genus Acanthosaura from Yunnan.* By G. A. BOULENGER, F.R.S.

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Acanthosaura varcoe.

Head once and one-third as long as broad; snout a little longer than the diameter of the orbit; canthus rostralis and superciliary edge sharp; tympanum nearly as large as the eye-opening; upper head-scales unequal, granulate and keeled, a few, near the ear, raised and spine-like; 14 or 15 scales in a transverse series between the superciliary edges; 8 upper and as many lower labials; gular scales smaller than largest ventrals. A strong oblique fold in front of the shoulder. Body neither compressed nor depressed; dorsal scales very unequal in size, imbricate, strongly keeled; nuchal crest very low, continued on the body as a series of enlarged, strongly keeled scales; two interrupted series of strongly enlarged, strongly keeled scales along each side of the back; ventral scales strongly keeled and mucronate, the median smaller than the laterals. Fourth finger a little longer than third. Hind limb reaching the ear in the male, the shoulder in the female. Tail cylindrical, not crested. Yellowish or reddish brown above, male with a cream-coloured dorso-lateral band; 5 chevron-shaped blackish bars across the back; sides with a wide-meshed black network; an oblique black streak from the lower eyelid to the commissure of the jaws; upper lip cream-colour; limbs with black cross-bars; lower parts white.

	♂. mm.	♀. mm.
Total length	168	187
Head	19	19
Width of head	14	14
Body	44	53
Fore limb.....	31	31
Hind limb	43	43
Tail	105	115

Two specimens, preserved in the British Museum—a male from Yunnan Fou and a female from Wuting Chu,—received from Mr. J. Graham in 1914.

The species is named after Mrs. Graham (maiden name, Varcoe).

XVII.—Notes on the Braconidæ in the British Museum.—

IV. On new Helconinæ, mostly Australian. By ROWLAND E. TURNER, F.Z.S., F.E.S.

Key to the Australian Genera of Helconinæ.

- | | |
|---|--------------------------------|
| 1. Recurrent nervure received by second cubital cell | <i>Megalohelcon</i> , gen. n. |
| Recurrent nervure received by first cubital cell | 2. |
| 2. Median lobe of mesonotum depressed below the lateral lobes | <i>Parahelcon</i> , Kokuji. |
| Median lobe of mesonotum not depressed .. | 3. |
| 3. Anal cell of fore wing with two fully developed transverse nervures; first tergite large, constricted at one-third from the base, the basal portion bilobed and massively subtuberculate on each side of the anterior margin | <i>Calohelcon</i> , gen. n. |
| Anal cell of fore wing with one transverse nervure, rarely with indications of the second; first tergite not abnormal | 4. |
| 4. Frontal excavation present | 5. |
| Frontal excavation absent | <i>Aspidocolpus</i> , Wesm. |
| 5. Anal cell of fore wing with indications of a second transverse nervure | <i>Gymnoscelus</i> , Först. |
| Anal cell of fore wing without any indication of a second transverse nervure | 6. |
| 6. Median segment and two basal tergites clothed with dense grey pubescence; second tergite with a median longitudinal carina .. | <i>Trichiohelcon</i> , gen. n. |
| Median segment and abdomen without dense pubescence; second tergite without a carina | <i>Austrohelcon</i> , gen. n. |

Typical *Gymnoscelus* has the second transverse vein of the anal cell fully developed.

MEGALOHELCON, gen. nov.

Mandibles bidentate at the apex, the inner tooth much longer than the outer; anterior margin of the clypeus straight. Face produced into a spine above the base of the clypeus, with a curved carina on each side near the inner margin of the eyes; cheeks as long as the third joint of the flagellum. Head large, transverse, as broad as the thorax; eyes broadly oval, ocelli very large; frontal depression not well defined. Antennæ about 77-jointed. Median lobe of the mesonotum

broad, slightly depressed in the middle, the parapsidal furrows very broad and deep. Median segment areolated. Abdomen elongate-fusiform, slender at the base; the apical dorsal segment narrow, with short cerci, terebra very short. Radial cell not quite extending to the apex of the fore wing; first cubital cell only divided from the discoidal on the apical half, the cubital nervure obsolete on the basal half of the cell; second cubital cell long and narrow, about half as long again on the cubitus as on the radius; second transverse cubital nervure oblique, sloping outwards from the cubitus to the radius, less than half as long as the second abscissa of the radius; recurrent nervure received near the base of the second cubital cell; anal cell with only one transverse nervure, nervulus slightly postfurcal.

Megalohelcon torresensis, sp. n.

♀. Testacea; mandibulis apice nigris; alis hyalinis, venis fuscis; cellula radiali margine costali anguste infuscata.

Long. 22 mm.

♀. Antennæ as long as the thorax and abdomen combined, second joint of the flagellum a little longer than the third, twice as long as the first. Face rugulose, mesonotum finely and closely punctured; pleuræ almost smooth, the grooves very coarsely crenulated. Dorsal surface of the median segment about equal to the scutellum in length; with a median carina and a slightly oblique lateral carina on each side, all meeting the strong apical transverse carina; on each side of the segment is a strong carina reaching from the base to the very large elongate spiracle; the apical slope of the segment has a small oval area at the base, with a median longitudinal carina beyond it; near the lateral margins are two longitudinal carinæ on each side. First tergite more than three times as long as its apical breadth, the spiracles just beyond one-third from the base, subtuberculate. Apical ventral segment strongly compressed laterally, the terebra very short, only slightly exerted, probably usually withdrawn.

Hab. Islands in Torres Straits.

In the position of the recurrent nervure this resembles the genus *Brulleia*, Szépl., but is very distinct otherwise. Doubtless the large ocelli, the long antennæ, and the pale colouring indicate nocturnal habits. All other *Helconinæ* recorded from Australia are from S.E. Australia and Tasmania, and I never saw any species of the group during my long residence in North Queensland.

Genus *PARAHELCON*, Kokuji.*Parahelcon*, Kokuji. Revue Russe Ent. i. p. 14 (1901).*Parahelcon konowi*, Kokuji.*Parahelcon konowi*, Kokuji. Revue Russe Ent. i. p. 15 (1901). ♀.
Opius euthyrrhini, Cum. Proc. Linn. Soc. N.S.W. xxxvii. p. 19 (1912). ♀.*Hab.* Gosford, N.S.W.

This genus is easily distinguished by the strongly depressed median lobe of the mesonotum. The neurulation is as in *Gymnoscelus*; the anal cell has two cross-nervures, but the second is incomplete. The second transverse cubital nervure meets the cubitus at right angles, not oblique as in typical *Gymnoscelus*.

CALOHELCON, gen. nov.

Anal cell of fore wing with two transverse nervures; nervulus interstitial or very slightly postfurcal; second transverse cubital nervure slightly oblique, not quite at right angles to the cubitus; first discoidal cell with a very short petiole, almost sessile. Frontal excavation fairly deep; median lobe of the mesonotum normal; parapsidal furrows not very deep, not crenulated. Median segment smooth, not areolated. First tergite as broad at the apex as the second, narrowed at about one-third from the base, the basal portion bilobed on the anterior margin and swollen on each side, at least as long as the apical breadth, twice as broad at the apex as at the base. Terebra at least as long as the whole insect.

Type of the genus, *C. obscuripennis*, Turn.

Calohelcon obscuripennis, sp. n.

♀. Nigra; capite rufo, antennis nigris; segmento mediano dimidio apicali, segmento abdominale primo, macula mediana dorsali subapicali nigra, albidulis; alis fusco-hyalinis.

♂. Feminæ similis.

Long., ♀, 15 mm., terebræ long. 17 mm.; ♂, 14 mm.

♀. Clypeus narrowly depressed at the apex, the apical margin straight, not reaching the mandibles in the middle. Head massive, broader than the thorax, vertex and front smooth and shining, a short longitudinal carina between the antennæ; face finely punctured, with an impressed longitudinal line on each side from the base of the antennæ to the

clypeus; posterior ocelli twice as far from the eyes as from each other. Antennæ about 50-jointed, second joint of the flagellum fully three times as long as the first. A large curved depression, longitudinally striated, at the base of the scutellum. Thorax and median segment smooth and shining. Abdomen smooth and shining, the valvulæ clothed with short hairs. Spiracle of the median segment small and round.

Hab. Victoria (*French*), ex coll. Turner.

A variety in the British Museum collection without data has the prothorax and mesonotum red and measures 18 mm. in length. This may prove to be distinct or a local race. The length of the second abscissa of the radius seems to be variable in this species.

AUSTROHELCON, gen. nov.

Very near the genus *Gymnoscelus*, Först., differing in having only one transverse nervure in the anal cell of the fore wing instead of two, and the second transverse cubital nervure straight, forming a right angle with the cubitus, not oblique. The genus *Edyia*, Cam., from Borneo, is somewhat intermediate between the two genera, having the second cubital cell as in *Gymnoscelus*, but the second transverse vein of the anal cell almost obsolete. The frontal excavation is shallower and less sharply defined than in *Gymnoscelus* and *Edyia*. The nervulus in *Edyia* and *Austrohelcon* is distinctly postfurcal, not interstitial as in *Gymnoscelus*.

Type of genus, *A. meridionalis*, Turn.

Key to the Species of Austrohelcon.

- | | | |
|---|----|-----------------------------------|
| 1 Head black; thorax almost entirely rufo-testaceous. | 2. | |
| Thorax almost entirely black. | 4. | |
| 2. Joints 2-4 of the hind tarsi yellowish white. | 3. | |
| Third and fourth joints of the hind tarsi only whitish. | | <i>A. australianus</i> , Kokuji. |
| 3. Pronotum, base of scutellum, and the middle of the mesosternum black. | | <i>A. indultor</i> , Erichs. |
| Thorax entirely rufo-testaceous. | | <i>A. inornatus</i> , Kokuji. |
| 4. Head, except the ocellar region, red. | | <i>A. erythrocephalus</i> , Turn. |
| Head black. | | <i>A. meridionalis</i> , Turn. |

Austrohelcon meridionalis, sp. n.

♀. Nigra; clypeo apice mandibulisque basi fusco-ferrugineis; abdomine rufo-ferrugineo, valvulis terebræ nigris; antennis 43-articulatis, articulis 14-22 albido-flavis; pedibus rufo-testaceis, tibiis posticis tertio apicali, tarsis posticis articulo apicali, unguiculisque nigris; alis hyalinis, venis fuscis; tegulis testaceis. Long. 9-11 mm.; terebræ long. 13-14 mm.

♀. Clypeus short, the apical margin deflexed and straight, not reaching to the mandibles, leaving a space in which the ciliated labrum is exposed. Face closely punctured, with more or less developed striæ, and a low but distinct longitudinal carina. Front and vertex smooth and shining, the frontal depression large but not very deep, the lower portion distinctly margined laterally. Pronotum rugose; the median lobe of the mesonotum rather prominent, shining in front, coarsely and irregularly reticulate posteriorly, the parapsidal furrows very coarsely crenulated; lateral lobes of the mesonotum smooth and shining; pleuræ rugulose, the mesopleuræ smooth and shining in the middle; scutellum finely punctured, with a longitudinally striated depression at the base. Median segment coarsely and irregularly rugose reticulate. Abdomen smooth and shining; the first tergite with two longitudinal carinæ from the base to beyond the middle, the basal half finely punctured, about three times as long as its apical breadth. Hind metatarsus not quite as long as the three following joints combined. Radius not quite reaching the apex of the fore wing; second abscissa of the radius distinctly longer than the first, about equal to the second transverse cubital nervure; first discoidal cell distinctly petiolate.

Hab. Victoria (*French*).

The colour varies considerably, some specimens having the hind tarsi whitish yellow except at the extreme apex and some having the upper portion of the propleuræ fusco-ferruginous. A specimen from Hobart differs in having the hind metatarsus black and the second abscissa of the radius nearly half as long again as the second transverse cubital nervure.

Austrohelcon erythrocephalus, sp. n.

♀. Rufo-testacea; thorace nigro, propleuris supra ferrugineis; segmento mediano nigro-suffuso; tibiis posticis tertio apicali, metatarso postico dimidio basali, unguiculisque nigris; antennis

43-articulatis, articulis 15-25 albido-flavis; terebræ valvulis nigris; alis hyalinis, venis fuscis, tegulis testaceis.
Long. 9 mm.; terebræ long. 10 mm.

♀. Differs from *A. meridionalis* in having the face very finely punctured, without a carina; the median lobe of the mesonotum finely punctured, not reticulate posteriorly; the first tergite transversely rugulose, the two longitudinal carinæ stronger than in *meridionalis* and reaching almost to the apex, and the second cubital cell longer, somewhat narrowed to the apex, the second abscissa of the radius nearly twice as long as the second transverse cubital nervure, and about two-thirds of the length of the cubital margin of the cell.

Hab. Victoria (*C. French*).

A specimen from Franklin, Tasmania, has the hind tarsi whitish yellow except at the base and apex, but in the type also they are much paler than the other tarsi, and would probably be whitish yellow in life.

I have not seen either *A. indultor*, Erichs., or *A. australianus*, Kokuj. A specimen of *A. inornatus*, Kokuj., differs from the type in having joints 15-21 of the antennæ whitish instead of 15-24 as in the type, and the antennæ only 39-jointed instead of 45; but another specimen has 41 joints with joints 15-22 whitish. The female of *inornatus* has the terebra equal in length to the whole insect. Probably, as Kokouyew suggests, *inornatus* will prove to be a variety of *indultor*. The three species of *Austrohelcon* known to me all have the clypeus short and the labrum exposed.

TRICHIOHELCON, gen. nov.

♀. Closely allied to *Austrohelcon*, differing in the deeper frontal excavation, in the strong longitudinal median carina of the second tergite, and in the dense hairy covering of the median segment and of the first and second tergites.

Type of the genus, *Iphiaulax phoracanthæ*, Frogg.

Trichiohelcon phoracanthæ, Frogg.

Iphiaulax phoracanthæ, Frogg. *Agricult. Gazette of New South Wales*, xxvii. p. 565 (1916). ♀.

♀. Nigra; capite rufo; segmento mediano, tergitisque primo secundoque albo-cinereo-hirsutis; alis fusco-hyalinis, venis nigris.
Long. 11 mm.; terebræ long. 11 mm.

♀. Antennæ 48-jointed; head shining, the face finely

punctured; clypeus short, the anterior margin straight, not reaching the mandibles, labrum exposed. Mesonotum and pleuræ shining, smooth, the median lobe of the mesonotum prominent, parapsidal furrows deep. First tergite less than twice as long as its apical breadth.

Hab. S.E. Australia and Tasmania.

A parasite on *Phoracantha* larvæ. Placed in *Iphiaulax* by Froggatt on the determination of C. Morley.

Genus GYMNOSCELUS, Först.

Gymnoscelus rufoniger, sp. n.

♀. Nigra, capite thoraceque rufis; antennis, postscutelloque nigris; segmento mediano nigro, dense albido-piloso; coxis anticis rufis; alis fusco-hyalinis, venis fuscis; antennis 45-articulatis. Long. 10 mm.; terebræ long. 8 mm.

♀. Head broader than the thorax, smooth and shining, the face very minutely punctured. Clypeus truncate at the apex, the labrum slightly exposed; cheeks long, only a little shorter than the eyes; frontal excavation deep. Thorax smooth and shining, the median lobe of the mesonotum rather prominent; parapsidal furrows well marked, very finely crenulated in the middle, the extremities smooth; a curved and strongly longitudinally striated depression at the base of the scutellum. Median segment densely covered with whitish hairs, not areolate. Abdomen smooth and shining, not quite as long as the head, thorax, and median segment combined, fusiform; the first tergite about half as long again as its apical breadth, covered with close-lying white hairs, not carinated. Hind coxæ subopaque, closely and minutely punctured, sparsely covered with white hairs. First discoidal cell sessile, nervulus slightly postfurcal, anal cell of fore wing with two transverse nervures, the second partly obsolete. First abscissa of the radius very short, second half as long again as the second transverse cubital nervure, the latter straight, forming a right angle with the cubitus.

Hab. Hobart, Tasmania (*J. J. Walker*); Victoria (*French*).

In the Victorian specimen the white hairs spread on to the sides of the second tergite. The species is not a typical *Gymnoscelus*, differing in the shape of the second cubital cell and in the partial effacement of the second transverse vein of the anal cell. It forms a link between *Gymnoscelus* and *Trichiobelcon*, differing from the latter in the absence of a

carina on the second tergite and the partial development of the second transverse vein of the anal cell.

Gymnoscelus rufithorax, sp. n.

♂. Gracilis, niger; thorace rufo; segmento mediano nigro, rugoso; alis hyalinis, venis fuscis; antennis 32-articulatis; tarsis intermediis articulis tertio quartoque pallide brunneis.

Long. 6 mm.

♂. Head broader than the thorax, finely and closely punctured, the face more closely punctured than the vertex and clothed with short white pubescence; clypeus truncate at the apex; cheeks about half as long as the eyes; frontal excavation very shallow and ill-defined, a low carina from between the antennæ to the anterior ocellus. Thorax finely and closely punctured; the median lobe of the mesonotum not prominent; parapsidal furrows clearly defined, finely crenulated. Basal half of the scutellum depressed and strongly longitudinally striated; median segment very coarsely rugose, not areolate. Abdomen very slender, as long as the head, thorax, and median segment combined; the first tergite nearly as long as the remainder of the abdomen, gradually broadened from the base, three times as long as its apical breadth, transversely rugulose, with two longitudinal carinæ from the base extending for fully three-quarters of the length of the tergite, the extreme apex smooth and shining. Hind coxæ closely and finely punctured and sparsely clothed with white hairs, hind calcaria very short. First discoidal cell sessile, anal cell with two transverse nervures; second abscissa of the radius nearly twice as long as the first, equal in length to the second transverse cubital nervure, only half as long as the cubital margin of the cell; second transverse cubital nervure straight, forming a right angle with the cubitus.

Hab. Melbourne, Victoria (*French*).

This differs from typical *Gymnoscelus* in the very shallow and almost obsolete frontal excavation, in which point it approaches *Aspidocolpus*. But the second transverse vein in the anal cell is present as in *Gymnoscelus*.

Genus ASPIDOCOLPUS, Wesm.

Aspidocolpus penetrator, Sm.

Rhogas penetrator, Sm. Trans. Ent. Soc. London, p. 5 (1878). ♀.

This was erroneously placed in *Rhogas* by Smith. The

head is smaller and more transverse than is usual in the Helconinæ, and the abdomen is placed lower on the median segment, almost as low as in the Diopilinæ, to which subfamily the species shows some approach; but the abdomen is long and slender, and I think it is best placed here.

Hab. New Zealand.

Genus BRULLEIA, Szépl.

Brulleia chinensis, sp. n.

♂. Rufo-ochraceous; flagello, articulo basali excepto, mandibulis apice, abdomine segmentis tertio, basi excepto, sequentibusque, tibiis posticis dimidio apicali, tarsisque posticis, articulo apicali excepto, nigris; alis flavo-hyalinis, venis ferrugineis, stigmatibus costaque nigris.

Long. 20 mm.

♂. Mandibles bidentate at the apex, the upper tooth distinctly longer than the lower; clypeus short, truncate at the apex, the labrum exposed. Head transverse, broader than the thorax, the whole, including the labrum, very finely and closely punctured; frontal excavation not very deep, but well defined; eyes about three times as long as the cheeks. Antennæ long, broken at the apex beyond the thirty-sixth joint. Thorax finely and closely punctured; middle lobe of the mesonotum not prominent; parapsidal furrows deep, crenulated; postscutellum distantly longitudinally striated. Median segment rugose, with an indistinct semicircular basal area and two indistinct longitudinal carinæ very close together near the middle; these carinæ diverge on the apical slope, enclosing a small semicircular area; the lateral margins of the segment with strong carinæ, the spiracles large and oval; a longitudinal striated groove below the spiracles. First tergite rugose, broadened from the base, three times as long as its apical breadth, with a longitudinal carina running from each of the basal angles nearly to the middle; second tergite finely punctured-rugulose in the middle, the remainder of the abdomen very finely and closely punctured. Hind metatarsus as long as the four apical tarsal joints combined. Anal cell with two transverse nervures. First discoidal cell sessile; recurrent nervure received by the second cubital cell near the base; second abscissa of the radius nearly twice as long as the first, fully as long as the second transverse cubital nervure, which is oblique, but not bent; nervulus interstitial.

Hab. North China.

The type of the genus is from New Guinea, but this appears to be congenerie.

Genus *HELCON*, Nees.

Helcon unicornis, sp. n.

♀. Nigra; mandibulis basi, coxis trochanteribusque posticis, femoribusque posticis, apice nigro excepto, ferrugineis; tegulis, palpis, segmento abdominali primo, pedibusque anticis intermediiisque testaceo-ferrugineis; tarsis posticis, articulo apicali excepto, albidis; antennis 37-articulatis, articulis 10 basalibus fusco-brunneis, 11-18 albis, apicalibus nigris; alis hyalinis, venis fuscis.

Long. 9 mm.; terebræ long. 6 mm.

♀. Face rugose, with a few oblique striæ on each side; vertex and front smooth and shining; the frontal depression not very deep, but strongly margined laterally, from the anterior portion of the depression rises a strong blunt horn, which rises higher than the raised lateral margins of the depression. Cheeks more than half as long as the eyes. Thorax closely and rather finely punctured; median lobe of the mesonotum not prominent; parapsidal furrows crenulated; mesopleuræ smooth and shining; the mesonotum behind with distinct transverse striæ in the middle; basal half of the scutellum occupied by a deep longitudinally striated depression. Median segment transversely rugulose, with four strong longitudinal carinæ on the dorsal surface, the sides of the segment rugose-reticulate. First tergite rather coarsely punctured-rugulose, a little more than twice as long as its apical breadth; second tergite indistinctly punctured-rugulose at the base, shining at the apex; the apical tergites smooth and shining. Hind femora very finely serrate in the middle beneath, with a stout spine beneath before the apex. The second transverse nervure in the anal cell of the fore wing is only faintly indicated. First discoidal cell distinctly petiolate; second abscissa of the radius less than twice as long as the first, as long as the second transverse cubital nervure, less than half as long as the cubital margin of the cell; second transverse cubital nervure oblique; nervulus slightly postfurcal.

Hab. French Indo-China (received from *A. Vuillet*).

The frontal excavation is smaller than is usual in the genus, and does not extend as high as the anterior ocellus, differing in this respect from the Japanese *H. cornutus*, Cam., in which the excavation is very large and deep.

Genus CÆLOSTEPHANUS, Kieff.

Cælostephanus, Kieff. Ann. Soc. Entom. France, p. 232 (1911).

This genus, created by Kieffer for the Mexican *C. rufus*, Kieff., must sink as a synonym of *Gymnoscelus*. The hind femora are missing in the type. The first tergite is smooth, and the second transverse cubital nervure is not oblique; otherwise it does not differ appreciably from *Gymnoscelus*. Kieffer placed his genus in the Stephanidæ, quite erroneously.

XVIII.—Contributions to a further Knowledge of the Rhynchotal Family Lygæidæ. By W. L. DISTANT.

[Continued from vol. i. (ser. 9) p. 424.]

Æthalotus apicimaculatus, sp. n.

Head, pronotum, scutellum, and corium black, finely, more palely pilose; bases of the pedunculated eyes and narrow base of head, an obscure narrow central line to pronotum, an apical spot to scutellum, connexivum, lateral areas of head beneath, broad lateral margins to sternum, and body beneath more or less dark ochraceous; legs, rostrum, and antennæ black; antennæ with the second joint longer than the third, which is almost subequal in length to fourth joint; eyes strongly pedunculate; the pale apex to the scutellum somewhat globose; pronotum finely, obscurely punctate; membrane slaty grey, the veins black, not reaching abdominal apex.

Long. 5 mm.

Hab. East Africa [German]; Lulanguru (G. O. H. Carpenter).

Lygæus montislunæ.

Spilostethus montislunæ, Bergr. Rev. Zool. Afric. iii. p. 456 (1914).

This species originally described from Uganda has also been received by the British Museum from Abyssinia; Managasha (*P. C. Zaphiro*).

Lygæus fimbriatus.

Lygæus fimbriatus, Dall. List. Hem. ii. p. 546 (1852); Dist. Faun. Brit. Ind., Rhynch. ii. p. 7 (1904).

This species has now been received from Ceylon; Peradeniya.

Ann. & Mag. N. Hist. Ser. 9. Vol. ii. 13

Lygæus negus, sp. n.

Sanguineous; apex of head and a spot at inner margins of eyes, anterior margin of pronotum and two large subquadrate spots on disk not quite reaching posterior margin and anteriorly, outwardly, narrowly connected with lateral margins, scutellum (excluding apex), posterior half of clavus, lateral margins, and a central rounded spot connected with the same black; body beneath sanguineous, posterior sternal areas greyish white and laterally spotted with black; antennæ, legs, and lateral margins of abdomen black; antennæ with the second joint longest, third and fourth almost subequal in length; pronotum centrally longitudinally carinate; scutellum robustly carinate on apical half; membrane passing abdominal apex, fuliginous, the veins on extreme basal area black.

Long. 8 mm.

Hab. Abyssinia; Higo Samula (*R. J. Stordy*).

Allied to *L. bettoni*, Dist., from Brit. E. Africa.

Lygæus dives, sp. n.

Ochraceous; apex of head and a large spot at inner margin of each eye, pronotum with the anterior marginal area and two large subquadrate spots (anteriorly nearly united to each other centrally and to the lateral margins perfectly), scutellum (excluding apex), corium with the outer claval margin and a darker spot at inner claval apex, lateral margin (not extending to apex), a darker spot near middle of lateral area, membrane, rostrum, and legs black; head beneath and sternum black, margins of the sternal segments greyish white, a prominent ochraceous spot near lateral margins of each segment, and a few darker black spots; abdomen beneath dull testaceous with a broad central fascia and narrow lateral margins black; antennæ mutilated; black markings above more or less obscurely punctate; an oblique incision on each side of the anterior pronotal area between the black markings; rostrum reaching the posterior coxæ.

Long. 7 mm.

Hab. Uganda; Mutanda (*C. H. Marshall*).

Allied to the preceding species, *L. negus*, Dist.

Graptostethus pictus, Dist. (Ann. & Mag. Nat. Hist. (7) vii. p. 538, 1901).

This species, formerly only known from Natal and Transvaal, can now be also recorded from N.E. Rhodesia; Upper

Luangwa R. (S. A. Neave). East Africa [German] Rd. to Kilossa, Usagara Dist. (S. A. Neave).

Graptostethus carpenteri, sp. n.

Head and antennæ black; pronotum testaceous with a large basal black spot at each posterior angle; scutellum black; corium greyish ochraceous, an elongate black spot on apical half of clavus and a central rounded black spot abutting on middle of costal margin; membrane black with a transverse spot attenuated interiorly and a somewhat large apical spot greyish white; connexivum ochraceous with black spots; body beneath pale purplish red, coxal areas paler and more greyish in hue; head beneath, rostrum, legs, two sternal spots on each lateral margin, small lateral abdominal segmental spots, and the apical abdominal segment black; antennæ with the second, third, and fourth joints almost subequal in length; scutellum longitudinally carinate on apical half; membrane passing abdominal apex.

Long. $4\frac{1}{2}$ –5 mm.

Hab. East Africa [German], Lulanguru (G. D. H. Carpenter).

Allied to *G. pictus*, Dist.

Graptostethus flammatus, sp. n.

Testaceous red; apex of head and a small spot at inner margin of each eye, pronotum with the anterior marginal area and a large spot on each side of disk, scutellum (excluding apical central carination), corium with the clavus, internal area and a sublateral marginal spot beyond middle, membrane, body beneath, rostrum, antennæ, and legs black; lateral margins of sternum and abdomen and abdominal disk more or less testaceous; sternal and coxal margins greyish white; antennæ with the second joint about three times as long as the first; head and pronotum more or less obscurely punctate; basal angles of pronotum moderately rounded, the lateral margins moderately thickened and slightly recurved; scutellum prominently centrally carinate.

Long. 12 mm.

Hab. Uganda; Kampala (C. C. Gowdey and S. A. Neave).

A species somewhat superficially resembling above the well-known palæarctic *Lygæus familiaris*, Fabr.

Graptostethus swynnertoni.

Lygæus swynnertoni, Dist. Ann. Mag. Nat. Hist. (8) xv. p. 504 (1915).

The typical specimen described did not afford me a good

opportunity of detecting the posteriorly obliquely truncate metapleuræ. I have now had the opportunity of examining a good series of specimens.

Hab. South Rhodesia (*C. F. M. Swynnerton*). Gaza Land; nr. Chirindi Forest (*G. A. K. Marshall*). Nyasaland; Mlanje (*S. A. Neave*).

The British Museum also now possesses a specimen labelled "near Sfax, Tunis (*de Boerio*)," a locality which I consider doubtful.

Pyrrhobaphus guttaticollis, sp. n.

Dull purplish red, more or less pale ochraceously or greyishly pilose; eyes black; pronotum with the anterior marginal area piceous and containing two dark black spots, two somewhat similar spots in transverse series on pronotal disk, and two larger and somewhat subquadrate spots at base, scutellum and membrane black, the latter with its basal angle and apical margin greyish white; body beneath thickly greyishly pilose, sternal and abdominal segments with prominent lateral black spots; legs black, greyishly pilose; antennæ with the basal joint ochraceous and its extreme base sanguineous, remaining joints black, extreme base of second joint ochraceous, second joint a little longest, third and fourth almost subequal: anterior marginal area of pronotum posteriorly defined by a waved, obliquely rounded incised black line; scutellum more thickly pilose, with a T-shaped discal carination; rostrum black.

Long. 14 mm.

Hab. Malay Archipelago; Damma Isld. (*J. J. Walker*).

Cænocoris torridus, sp. n.

Above dull testaceous red; antennæ, eyes, anterior area of pronotum (excluding extreme anterior margin), scutellum (excluding apex), and membrane black or blackish; sternum pale sanguineous with large coxal blackish spots; abdomen beneath dull ochraceous, the discal posterior areas of the segments black; rostrum, legs, and antennæ black; fourth joint of antennæ considerably longest, second and third almost equal in length; head above discally convex; pronotum coarsely punctate; scutellum centrally longitudinally carinate, the carination not reaching base, its apex sanguineous; clavus rather more very dull greyish than remainder of corium; membrane with the basal angle dark indigo-blue, its apical margin hyaline; rostrum reaching apical margin of second abdominal segment.

Long. 11–13 mm.

Hab. Queensland ; Townsville (F. P. Dodd). Cooktown (Philip de la Garde).

Cænocoris floridulus, sp. n.

Head, pronotum, scutellum, and corium bright sanguineous ; membrane, antennæ, rostrum, and legs (including coxæ) black ; head beneath, lateral areas of sternum, and the abdomen beneath sanguineous, the stigmatal spots more or less black ; basal joint of antennæ reddish ochraceous, apical joint about as long as second and third joints together ; pronotum very coarsely punctate ; scutellum strongly, centrally, longitudinally carinate, the carination not reaching base ; membrane somewhat bluish black, its extreme basal angle testaceous, its apical margin subhyaline ; rostrum very long, almost or quite reaching the apical abdominal segment.

Long. 18–20 mm.

Hab. Indo-China ; Tonkin, Laos, Vientiane (R. V. de Salvaza).

Allied to *C. augur*, Stål, from Queensland.

Macropes albosignatus, sp. n.

Black ; a large subquadrate spot on each lateral margin of corium, a subbasal transverse arcuated fascia and a broad apical fascia to membrane greyish white ; basal joint of antennæ ochraceous (remainder mutilated) ; anterior lobe and base of posterior lobe of pronotum shining black, and sparsely punctate, the intermediate area opaque and thickly coarsely punctate, on the anterior lobe are two discal foveate impressions, posterior pronotal margin concavely sinuate before base of scutellum which is longitudinally carinate ; membrane almost reaching base of penultimate abdominal segment.

Long. $9\frac{1}{2}$ mm.

Hab. N.E. Rhodesia ; near Petauke, 200–400 feet (S. A. Neave).

This fine species is represented by a somewhat strongly carded specimen, so that it is not possible to describe the under surface. It is allied to *M. sultanus*, Dist., from Zanzibar.

Macropes nigrolineatus, sp. n.

Ochraceous; three lineate, longitudinal spots between eyes, narrow anterior margin, and two large spots at basal margin of pronotum, inner claval margin, a transverse macular fascia near middle of clavus, a submarginal narrow longitudinal fascia, and an apical central line to abdomen above—visible through the transparent tegmina—black; body beneath imperfectly seen in carded type; antennæ ochraceous, apical joint claviform, scarcely longer than the preceding joint; head and pronotum coarsely punctate; scutellum finely centrally longitudinally carinate; corium somewhat finely punctate; anterior femora incrassated and spined beneath.

Long. 5 mm.

Hab. East Africa [German]; Lulanguru, 17 miles W. of Tabora—on bushes (*G. D. H. Carpenter*).

Germalus humeralis, sp. n.

Ochraceous; pronotum (excluding anterior marginal area), clavus, outer claval area, and pale suffusion at base of membrane pale bluish-grey; eyes castaneous, inclining to sanguineous; body beneath and legs pale ochraceous, abdomen beneath with a sublateral, sanguineous, linear fascia; antennæ ochraceous, the first and fourth joints darker, second joint longer than either third or fourth; head above with an oblique dark line from ocelli to eyes and in some specimens a cruciform dark spot on its apical area; pronotum with an anterior submarginal transverse series of punctures, the bluish-grey area coarsely punctate, the posterior angles distinctly black and subnodulose; scutellum coarsely and prominently carinate, obliquely from each basal angle to before middle and thence longitudinally to apex, the non-carinate portion punctate, and sometimes more or less testaceous; corium with the lateral margin pale and impunctate; membrane hyaline reflecting the testaceous abdomen beneath which has also a central longitudinal dark fascia.

Long. $4\frac{1}{2}$ –5 mm.

Hab. Queensland; Townsville (*F. D. Dodd*).

Germalus coloratus, sp. n.

Head ochraceous with three black spots—one near apex, and one before each eye; eyes purplish red; pronotum

bluish-grey, coarsely darkly punctate, two slightly oblique, impunctate, ochraceous spots in transverse series on apical area, the posterior angles prominently black; scutellum bluish-grey, prominently, cruciately, ochraceously carinate; corium subhyaline with its apical margin black, reflecting the dark abdomen beneath which is black, and with the lateral margins and some central spots dark ochraceous; body beneath and legs ochraceous; antennæ pale ochraceous, the apical joint darkest, shorter than the second, but longer than the third.

Long. 5 mm.

Hab. Queensland; Kuranda (*T. P. Dodd*).

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With 3 text-figures and 1 map. By S. F. HARMER, Sc.D., F.R.S.,
Keeper of the Department of Zoology. London: printed by
Order of the Trustees of the British Museum. 1918.

THIS Report, the fifth in succession, records the stranding during the year 1917 of 31 Cetaceans, belonging to at least 12 species, on the coasts of the British Islands. Several of these are of quite exceptional interest, and the male cachalot (*Physeter catodon*), nearly 60 feet in length, which was found floating dead in the Moray Firth and towed to the Caithness coast by a patrol boat, heads the list in point of size. Other noteworthy records are those of the rare northern white-sided dolphin (*Lagenorhynchus acutus*) from Skegness, Lincs, observed for the first time in English waters; the equally rare Risso's grampus (*G. griseus*) and Cuvier's beaked whale (*Ziphius cavirostris*) from the coasts of South Devon and Clare respectively; and the large rorqual, probably *Balenopectera physalus*, from the Scilly Islands. An interesting summary of the occurrence and distribution of the commercially valuable bottle-nosed whale (*Hyperoodon rostratus*) in British waters appears on p. 16. Although some of the animals were, when found, in very bad condition, it is satisfactory to learn that in many cases it was found possible to preserve the jaws and other hard parts for identification and future reference; and due acknowledgment is given to the assistance of the coastguard and other authorities in these observations, in the midst of more exacting duties.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

June 5th, 1918.—Mr. G. W. Lamplugh, F.R.S.,
President, in the Chair.

The following communication was read:—

‘The Kelestominæ, a Sub-Family of Cretaceous Cribrimorph Polyzoa.’ By William Dickson Lang, M.A., F.G.S.

The Kelestominæ are a sub-family of Pelmatoporidae. The latter are a family of Cretaceous cribrimorph Polyzoa, whose costæ are prolonged upwards as hollow spines from the median area of fusion of the intraterminal front-wall. The broken ends of these spines form a row of pelmata (or, if small, pelmatidia) on the intraterminal front-wall.

The Kelestominæ are Pelmatoporidae with an apertural bar each half of which is bifid; and the proximal and distal forks of each half are fused with the corresponding forks of the other half. The fused distal forks are also fused with the proximal pair of apertural spines, which are greatly enlarged.

The simplest known form of this arrangement is seen in the genus *Kelestoma* Marsson. *Kelestoma* is characterized among the Kelestominæ by its great œcial length, and by the great number of costæ. *Kelestoma* has the following three species, which form a single lineage:—(1) *Kelestoma elongatum* Marsson, with an incrusting asty; (2) a new species, with a bilaminar, erect asty; (3) *K. scalare* Lang, with an erect, cylindrical asty. There is, in this series, a slight catagenetic decrease in the number of costæ, and the avicularian aperture becomes somewhat more pointed. The genus occurs in the Senonian, zone of *Belemnitella mucronata*, in the island of Rügen.

Morphasmopora, unlike *Kelestoma*, retains a small number of costæ and a short œcium; but the thickness of the proximal apertural spines, which are hardly recognizable as such, is enormously increased; the thickness of the bifid apertural bar is also increased. In *Morphasmopora brydonei* Lang, there are four circum-apertural avicularia; and the proximal apertural spines and the apertural bar, though enormously developed, are not so large as in *M. jukes-brownei* (Brydone). The latter species has fewer costæ than the former, and but one pair of circum-apertural avicularia. There are also differences in the interœcial and interstitial secondary tissue of the two species. *M. brydonei* occurs in the island of Rügen and *M. jukes-brownei* at Trimingham; both from the Senonian, zone of *Belemnitella mucronata*.

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[NINTH SERIES.]

No. 9. SEPTEMBER 1918.

XIX.—*Descriptions of New Pyralidæ of the Subfamily Pyraustinae.* By Sir GEORGE F. HAMPSON, Bart., F.Z.S., &c.

[Continued from vol. i. p. 280.]

(3) *Megastes erythrostolalis*, sp. n.

♀. Head yellow suffused with red; thorax and abdomen pale red with a crimson tinge or sometimes with a red-brown tinge; palpi white at base; pectus, legs, and ventral surface of abdomen silvery white. Fore wing pale red with a crimson tinge, more or less strongly suffused with silvery grey, the costa yellow from before the antemedial line to the postmedial line; antemedial line hardly traceable except at costa, red, oblique to discal fold and with slight yellowish-white spots on its outer side in upper part of cell, below the cell, and above inner margin; a bar-shaped yellowish white spot in end of cell with its lower extremity rather angled inwards and a large lunulate spot below end of cell, both defined by crimson-red; postmedial line formed by slight brown lunules tinged with red, oblique to vein 6 and slightly incurved at discal fold, a small yellow spot beyond it above vein 7 and larger white spot above vein 6, then defined on each side by slight yellow marks to vein 2; the terminal area yellow irrorated with red, its inner edge waved; a brown terminal line; cilia yellowish white. Hind wing pale red with a crimson tinge and more or less suffused with leaden grey especially just beyond the postmedial line; a large yellowish white patch beyond the cell before the postmedial line narrowing to a point at vein 1, defined on inner

side by an oblique crimson-red line and with some crimson-red scales on it between veins 5 and 3; postmedial line, crimson-red defined on outer side by narrow yellow marks in the interspaces, slightly waved, excurved to vein 3 then incurved and ending at tornus; the terminal area yellow irrorated with red, its inner edge waved; a brown terminal line; cilia yellowish white. Underside silvery white, the terminal half of fore wing and the hind wing except the cell and costal and terminal areas faintly tinged with brown; the fore wing with slight brown discoidal bar, waved postmedial line bent inwards at vein 2 to below end of cell, and wedge-shaped red-brown postmedial patch from costa to vein 5; the hind wing with waved red-brown postmedial line, indistinct except between veins 6 and 5.

Hab. VENEZUELA, Esteban Valley, Las Quiguas (*Klages*), 2 ♀ type. *Exp.* 36-38 mm.

(6) *Omphisa leucostolalis*, sp. n.

♂. Head and thorax white mixed with some red-brown; abdomen white with red-brown segmental lines except on terminal segments and oblique blackish subdorsal streaks on segments 3 to 5, the anal tuft with some red-brown at base; palpi with black marks on the 1st and 2nd joints at sides and the 3rd joint black; pectus, legs, and ventral surface of abdomen white, the legs tinged with brown. Fore wing white irrorated with a few cupreous-brown scales, especially on basal area; antemedial line cupreous brown, oblique; a minute cupreous brown spot in middle of cell and discoidal bar with white striga on it, a point beyond lower angle of cell above base of vein 3; postmedial line cupreous brown, forming a semicircular mark at costa, slightly angled outwards below costa, then incurved, excurved between veins 5 and 4, then oblique to vein 2 where it is retracted upwards to lower angle of cell, then oblique to inner margin at the antemedial line; subterminal line cupreous brown, slightly angled inwards at vein 6, then obliquely excurved to vein 4, then oblique and sinuous to the sinus of the postmedial line at vein 2 and excurved above inner margin; a slight cupreous brown terminal line. Hind wing white; an oblique dark cupreous brown discoidal bar with an oblique slightly sinuous line from it to above tornus; postmedial line cupreous brown, arising below costa and oblique to tornus, slightly excurved between veins 5 and 4; subterminal line cupreous brown, excurved from vein 6 to 4, then oblique to just beyond the postmedial line at vein 2 where it terminates; a dark cupreous brown terminal line and line near base of cilia.

Hab. BR. C. AFRICA, Mt. Mlanje (*Neave*), 1 ♂ type. *Exp.* 34 mm.

(5 a) *Evergestis dognini*, n. n.

Evergestis obliquialis, Dogn. Ann. Soc. Ent. Belg. 1905, p. 75 (nec Grote, 1883).

PERU.

(5 b) *Evergestis inglorialis*, sp. n.

♂. Head, thorax, and abdomen reddish brown mixed with grey; antennæ dark brown; palpi, pectus, legs, and ventral surface of abdomen white tinged with brown. Fore wing grey strongly suffused with reddish brown; faint obliquely placed dark subbasal spots in and below the cell; antemedial line indistinct, dark, faintly defined on inner side by whitish, sinuous, oblique to median nervure, then inwardly oblique; a slight dark spot in middle of cell and diffused discoidal patch; postmedial line dark brown defined on outer side by whitish, excurved from below costa, where it is met by an oblique whitish shade from apex, to vein 6, then oblique; a rather triangular patch of dark suffusion on terminal area from below apex to vein 4 with a faint dark subterminal line from it to inner margin; a series of small dark spots before termen in the interspaces and a series of terminal black points on the veins. Hind wing semihyaline whitish tinged with brown, the terminal area rather narrowly suffused with dark brown; a terminal series of black points; cilia with a fine white line at base.

Hab. PERU, El Porvenir, 1 ♂ type, Chanchamayo, La Mercede (*Watkins*), 1 ♂. *Exp.* 36 mm.

(1 a) *Azochis trichotarsalis*, sp. n.

Hind tarsi of male fringed with hair above to extremity.

♂. Head and thorax white faintly tinged with brown, the frons dark brown, the neck and shoulders red-brown; abdomen red-brown with some white at base and a series of slight white dorsal spots, the anal tuft black tinged with grey; palpi dark brown above, white below; pectus, legs, and ventral surface of abdomen white, the fore tibiæ tinged with brown and black at extremity, the tarsi ringed with brown. Fore wing white, the costa suffused with bronze-brown, the basal area with some dark brown suffusion; antemedial line black-brown, curved and slightly waved; a small elliptical black-brown spot in upper part of cell towards extremity with white striga in centre; a black-brown discoidal bar with brownish white striga in centre and brown suffusion beyond and below it, defined by the black-brown medial line, which arises below the costa, slightly waved to vein 3, then retracted to below the discoidal bar and angled outwards above vein 1; postmedial line black-brown, waved, ending on termen at vein 1, with small black-brown spots on it below veins 3 and 2; black-brown striæ before termen above veins 7, 6 and a line between veins 6 and 4; cilia with a series of small dark brown spots. Hind wing semihyaline white; a faint sinuous brown line from lower angle of cell and a rather diffused black-brown patch at inner margin; postmedial line indistinct, brown, arising at vein 6, excurved from vein 5 to below 3 where it terminates; black-brown striæ before termen above and below vein 7 and a line from below vein 6 to above 4; cilia with a series of small black-brown spots at base to vein 2.

Hab. VENEZUELA, Esteban Valley, Las Quiguas (*Klages*), 1 ♂ type. *Exp.* 42 mm.

(6) *Azochis cymographalis*, sp. n.

Hind tibiæ of male at extremity and 1st joint of tarsi without fringes of hair.

♂. Head and thorax rufous mixed with grey; abdomen rufous mixed with some grey, some white at base and slight dorsal white spots on 2nd and 3rd segments, the anal tuft white tinged with brown; frons and palpi deep rufous, the latter white at base; pectus, legs, and ventral surface of abdomen white, the fore and mid legs rufous above. Fore wing white with a faint rufous tinge, the costa rufous; the base suffused with rufous and with a waved blackish line near base; a slightly curved rufous antemedial line; a rufous spot in upper part of cell near its extremity and rufous discoidal bar angled inwards on median nervure, some pale rufous suffusion beyond it and a waved rufous line from vein 2 below end of cell to inner margin; postmedial line rufous, crenulate, erect to below vein 3, then rather oblique to tornus; a rufous terminal line expanding into a slight spot at discal fold and a line near base of cilia. Hind wing semihyaline white with a faint rufous tinge; postmedial line rufous, arising at vein 7 and waved to vein 2, slightly bent outwards at vein 5, at vein 2 bent inwards and almost obsolete to below end of cell, then fuscous and forming a slight diffused patch at inner margin; a rufous terminal line to vein 2 and slight line near base of cilia.

Hab. ECUADOR, R. Pastaza, El Topo (*Palmer*), 1 ♂ type, El Rozario (*Palmer*), 1 ♂. *Exp.* 42-44 mm.

(20 a) *Cocidophora ruficostalis*, sp. n.

Fore wing of male with the retinaculum formed by a fan of scales, but without fan at upper angle of cell or postmedial costal swelling.

♂. Head and thorax yellow suffused with rufous; abdomen yellow tinged with rufous; palpi rufous with some white at base; pectus, legs, and ventral surface of abdomen pale yellow, the fore tibiæ with rufous band at extremity. Fore wing yellowish suffused with rufous, the base, costal and terminal areas deeper rufous; an indistinct diffused rufous antemedial line; a brown discoidal striga; postmedial line rather diffused rufous, obliquely curved to vein 2, then erect. Hind wing pale yellow tinged with rufous; an oblique rather diffused rufous postmedial line from costa to vein 2; a rufous terminal band from apex to vein 2; cilia rufous except towards tornus.

♀. Fore wing clearer yellow except the costal and terminal areas, the postmedial line more curved between veins 5 and 2; hind wing clear yellow except the terminal band, the postmedial line excurved between veins 5 and 2.

Hab. BR. C. AFRICA, Mt. Mlanje (*Neave*), 2 ♀; PORT. E. AFRICA, Ruu Valley (*Neave*), 4 ♂, 1 ♀, Mt. Chipirone (*Neave*), 3 ♂, 3 ♀ type. *Exp.* 30-34 mm.

(20 b) *Crocidophora megaptyona*, sp. n.

♂. Head, thorax, and abdomen yellowish suffused with rufous; palpi rufous, narrowly white in front to extremity of 2nd joint; pectus, legs, and ventral surface of abdomen white. Fore wing yellowish suffused with rufous, the costal area deeper rufous; an indistinct rather diffused rufous postmedial line, incurved below vein 3; a fine rufous terminal line. Hind wing yellowish white tinged with rufous; an indistinct diffused rufous postmedial line from costa to vein 2; the terminal area rufous to submedian fold; cilia tinged with rufous and with a slight rufous line near base to submedian fold. Underside of fore wing with the fan of scales very large and silvery leaden grey.

♀. Fore wing with dark discoidal striga.

Hab. "GERM. E. AFRICA," Dar-es-salaam, 1 ♂; BR. C. AFRICA, Mt. Mlanje (*Neave*), 1 ♀; PORT. E. AFRICA, Mt. Chipirone (*Neave*), 4 ♂, 1 ♀ type. *Exp.* 22-26 mm.

(28 a) *Crocidophora rufitinctalis*, sp. n.

♂. Head and thorax pale rufous; abdomen whitish tinged with rufous; palpi white at base; pectus, legs, and ventral surface of abdomen white. Fore wing pale rufous; an indistinct brownish postmedial line, excurved to vein 3, then retracted to median nervure before end of cell and erect to inner margin; cilia white at tips. Hind wing pale rufous, the cell and inner margin whitish; an indistinct brownish postmedial line from discal to submedian fold; cilia whitish at tips.

Hab. FORMOSA, Tainan (*Wileman*), 1 ♂ type. *Exp.* 24 mm.

(18 a) *Polygrammodes purpureorufalis*, sp. n.

♀. Head, thorax, and abdomen pale purplish red; palpi white below to near extremity of 2nd joint; pectus and ventral surface of abdomen white, the fore coxæ purplish red; (legs wanting). Fore wing pale purplish red; a faint brownish spot in upper part of cell towards extremity and discoidal bar; a faint obliquely curved brownish line beyond the cell with another line beyond it, erect to vein 5, then oblique. Hind wing pale purplish red, the costal area to near apex and the inner margin white.

Hab. PERU, Chanchamayo, 1 ♀ type. *Exp.* 52 mm.

(23 a) *Polygrammodes junctilinealis*, sp. n.

♀. Head and thorax white suffused with rufous; abdomen white tinged with yellow and with rufous towards extremity,

oblique black subdorsal streaks on 2nd to 5th segments; antennæ rufous; sides of frons, the 2nd joint of palpi above towards base, and the 3rd joint black; pectus, legs, and ventral surface of abdomen white, the fore legs tinged with rufous, the tibiæ with dark band at extremity, and the tarsi ringed with rufous. Fore wing yellowish white, the basal area, costal area to end of cell, the cell, and the veins of terminal half tinged with rufous; a red-brown streak below basal half of costa and diffused red-brown subbasal line from cell to inner margin; a red-brown spot in cell towards its extremity with elliptical red-brown spot below it in submedian interspace, and a quadrate discoidal patch with yellowish striga in centre; postmedial line strong, red-brown, waved, bent outwards between veins 8 and 7, then incurved, angled outwards at vein 5, then again incurved to vein 2 on which it is retracted to lower angle of cell, then oblique and from inner margin curved upwards to the spot below the cell; subterminal line red-brown, waved, excurved at vein 5, then oblique and joined above inner margin by an oblique bar from the angle of the postmedial line at vein 2, bent inwards on inner margin for a short distance; a red-brown terminal line. Hind wing yellowish white; a black-brown discoidal bar with strong slightly curved line from it to above inner margin; postmedial line strong, dark red brown, rather oblique to vein 6, angled outwards at vein 5, then slightly curved to inner margin near tornus, joined at vein 2 by a waved red-brown subterminal line, excurved at vein 5; a dark red-brown terminal line.

Hab. SIERRA LEONE, Kennema (*Mrs. Addison*), 1 ♀; UGANDA, Lake George (*Neave*), 1 ♀ type. *Exp.* 38–50 mm.

(25 e) *Polygrammodes flavescens*, sp. n.

♀. Head, thorax, and abdomen pale yellow tinged with rufous; palpi red-brown, white at base; pectus, legs, and ventral surface of abdomen ochreous white, the fore femora dark brown above and the tibiæ with dark band at extremity, the tarsi ringed with brown. Fore wing yellow tinged with rufous, the terminal area more suffused with rufous; a faint curved rufous antemedial line; a faint rufous point in middle of cell and discoidal bar; postmedial line pale rufous, slightly waved to vein 5, then excurved and crenulate to vein 2 on which it is retracted to below end of cell, then sinuous to inner margin; the inner edge of the rufous terminal area dentate; some yellow on termen in the interspaces; cilia white with a pale brown line at base. Hind wing pale yellow; a faint waved rufous line from beyond lower angle of cell to inner margin; postmedial line rufous, waved, arising at vein 6, excurved between veins 5 and 3, then oblique to termen above tornus; a slightly waved rufous subterminal line from costa to vein 2, the veins beyond it streaked with rufous; cilia white with a pale brownish line near base.

Hab. PERU, San Domingo (*Ockenden*), 2 ♀ type. *Exp.* 42 mm.

Genus *PACHYZANCLA*, insert

Type.

Psara, Snell. Tijds. v. Ent. xviii. p. 239 (1875) *periusalis*,

which has priority.

(1 a) *Psara palpalis*, sp. n.

Palpi of male curved outwards and widely separated to near tips, where they almost meet, fringed with hair above and below.

Head, thorax, and abdomen fuscous brown tinged with grey, the last with white segmental lines; frons and palpi black-brown, the latter fringed with white hair below to middle of 2nd joint; pectus, legs, and ventral surface of abdomen white tinged with red-brown, the fore tibiæ with black band at extremity. Fore wing white suffused with fuscous brown, the costal area and terminal area broadly fuscous brown tinged with grey; antemedial line blackish, oblique to median nervure; a small blackish spot in middle of cell and discoidal bar; postmedial line blackish defined on outer side by white, erect to vein 5, then excurved to below vein 3, where it is retracted to below end of cell, then oblique to inner margin; a fine whitish line at base of cilia. Hind wing fuscous brown tinged with grey; an oblique blackish discoidal bar; postmedial line blackish defined on outer side by whitish, bent outwards and slightly waved between veins 5 and 2; a slight blackish terminal line and white line at base of cilia.

Hab. CAMEROONS, Ja R., Bitje (*Bates*), 2 ♂, 4 ♀; BR. C. AFRICA, Mt. Mlanje (*Neave*), 1 ♂ type. *Exp.* 26–32 mm.

(1 b) *Psara barbipalpalis*, sp. n.

Palpi of male with the second joint fringed with very long hair in front.

♂. Head and thorax pale glossy grey-brown; abdomen whitish tinged with pale red-brown and with slight dark segmental lines, the extremity tinged with fuscous, the genital tufts white; palpi darker brown, white at base, the hair in front of 2nd joint reddish brown; pectus, legs, and ventral surface of abdomen white, the fore tibiæ with black band at extremity. Fore wing pale glossy grey-brown; a rather oblique dark antemedial line; a slight dark discoidal lunule; postmedial line dark, slightly excurved to below vein 3, then retracted to lower angle of cell and erect to inner margin. Hind wing pale glossy grey-brown; an oblique dark discoidal bar; postmedial slight, dark, curved, incurved at vein 2; cilia white with a brown line near base; the underside white faintly tinged with brown.

Hab. COLOMBIA, Don Amo (*H. H. Smith*), 1 ♂ type. *Exp.* 22 mm.

(20 b) *Psara normalis*, sp. n.

♂. Head, thorax, and abdomen pale grey-brown with a faint reddish tinge, the last with whitish segmental lines; palpi darker

brown, white below to near extremity of 2nd joint; pectus, legs, and ventral surface of abdomen white with a faint red-brown tinge, the fore tibiae brown. Fore wing grey-brown with a faint reddish tinge; antemedial line blackish, oblique to median nervure; a slight blackish spot in middle of cell and elliptical black discoidal spot; postmedial line blackish, erect to discal fold, then excurved to below vein 3 where it is retracted to below end of cell and excurved below submedian fold; a fine whitish line at base of cilia. Hind wing grey-brown with a faint reddish tinge; an oblique black discoidal bar; postmedial line indistinct, dark, rather diffused, excurved from discal fold to below vein 3, then retracted to below end of cell and excurved to inner margin; cilia with a fine white line at base, the tips whitish towards tornus.

Hab. ECUADOR, Loja (*Abbé Gaujon*), 1 ♂ type. *Exp.* 36 mm.

(20 c) *Psara retrorsalis*, sp. n.

♂. Head, thorax, and abdomen very pale reddish brown, the anal tuft white faintly tinged with red-brown; palpi brown, white in front to extremity of 2nd joint; pectus, legs, and ventral surface of abdomen white. Fore wing white suffused with pale red-brown, the marginal areas pale reddish brown; antemedial line pale brown, oblique; an oblique black discoidal striga; postmedial line pale brown defined on outer side by whitish, excurved from vein 5 to below 3, then retracted to just below angle of cell and slightly excurved above inner margin; cilia white tinged with brown. Hind wing very pale reddish brown; a faint oblique dark discoidal bar; postmedial line pale brown slightly defined on outer side by whitish, excurved and very slightly waved between veins 5 and 2, then retracted to below angle of cell and oblique to above tornus; cilia white with a pale brown line near base; the underside white with a faint brownish tinge, a blackish discoidal point.

Hab. ECUADOR, Zamora (*Abbé Gaujon*), 2 ♂ type; PERU, Carabaya, Huacamayo (*Ockenden*), 1 ♂. *Exp.* 26 mm.

(31) *Psara melanosoma*, sp. n.

♂. Head and thorax orange-yellow; abdomen orange-yellow suffused with blackish brown except the three basal segments dorsally; antennae blackish; frons with white lines at sides; palpi grey-brown, the basal joint and the 2nd joint in front at base white; pectus, legs, and ventral surface of abdomen pale grey-brown. Fore and hind wings uniform orange-yellow, the cilia white tinged with brown.

Hab. PERU, Carabaya, Oconeque (*Ockenden*), 2 ♂ type. *Exp.* 26-30 mm.

(6) *Rhectosomia vau-signalis*, sp. n.

♂. Head, thorax, and abdomen white mixed with pale red-brown and slightly irrorated with black, the last with white

segmental lines; antennæ tinged with red-brown; palpi pale reddish brown with some white at base; pectus, legs, and ventral surface of abdomen white mixed with pale reddish brown. Fore wing white mostly suffused with pale reddish brown and irrorated with a few black scales; a diffused band of black scales near base; an antemedial band of black scales, indistinct to submedian fold where it is angled outwards, then more distinctly black; a blackish striga in middle of cell and V-shaped white discoidal mark defined by diffused black; a pale reddish brown medial band, erect to median nervure before the discoidal mark, then very oblique and defined on outer side by a waved blackish line; elongate white marks below end of cell above and below vein 2; a faint dark post-medial line, oblique to vein 6, then erect, waved, and with some black scales on it to tornus, a rather triangular pale red-brown patch on terminal area between veins 7 and 3. Hind wing white; a terminal series of dark points to vein 2, a small black patch below vein 2 with a line from it to tornus; cilia with dark brown mixed towards tornus.

Hab. PERU, Carabaya, Oconeque (*Ockenden*), 1 ♂ type. *Exp.* 38 mm.

Genus *PHLYCTÆNODES* will stand as

	Type.
<i>Loxostege</i> , Hübn. Verz. p. 352 (1827)	<i>æruginalis</i> .

(51 a) *Loxostege obliquivialis*, sp. n.

♂. Head and thorax pale ochreous yellow, the patagia with red-brown patches at base, the dorsum of thorax red-brown; abdomen reddish brown, the basal segment ochreous, rufous behind, the anal tuft ochreous; antennæ brown; palpi with some blackish at tips; pectus, legs, and ventral surface of abdomen ochreous white. Fore wing pale ochreous; the cell and fascia below it to middle reddish brown; three obliquely placed reddish brown antemedial spots from below the cell to inner margin; a very oblique reddish brown post-medial band from below the costa to inner margin, conjoined to spots beyond the cell and below base of vein 2; an oblique sub-terminal series of reddish brown spots in the interspaces; a terminal series of small brown spots. Hind wing white, the costal area broadly and terminal area to submedian fold tinged with red-brown. Underside white, the fore wing and costal area of hind wing tinged with red-brown.

Hab. TRANSVAAL, Waterberg Distr. (*Zutrencka*), 1 ♂ type. *Exp.* 30 mm.

(53 a) *Loxostege aureodiscalis*, sp. n.

♀. Head whitish; thorax rufous mixed with whitish; abdomen black with white segmental bands and some rufous at base; antennæ blackish; sides of frons and palpi black, the latter white in

front to extremity of 2nd joint; pectus, legs, and ventral surface of abdomen white, the fore legs suffused with black-brown, the mid and hind legs with red-brown. Fore wing whitish thickly irrorated with rufous and dark brown, the costal area darker towards base; a dark antemedial shade; a whitish medial band thickly irrorated with rufous from subcostal nervure to inner margin; dark bars before and beyond the discocellulars; a whitish band thickly irrorated with rufous before the postmedial line from costa to below vein 3; postmedial line rather diffused black, slightly incurved at discal fold, below vein 3 retracted to lower angle of cell, then erect; cilia white with dark line at middle, the tips with brown mixed. Hind wing deep orange, the inner margin and terminal area black, the latter very broad at costa with its inner edge oblique to vein 4; a round black discoidal spot; cilia white with a dark line at middle. Underside of fore wing black irrorated with white, the basal inner area and bands orange-yellow; hind wing orange-yellow, the black discoidal spot and terminal band irrorated with white.

Hab. W. AUSTRALIA, Yallingup (*R. W. Turner*), 1 ♀ type.
Exp. 20 mm.

Genus *CALLIPHLYCTA*, nov.

Type, *C. metaxantha*.

Proboscis fully developed; palpi slightly fringed with hair above and below, in male with the 2nd joint obliquely upturned; the 3rd porrect and long, in female downcurved and extending about three times length of head; maxillary palpi minute; frons smooth, rounded; antennæ of male ciliated and minutely serrate; hind tibiæ with the outer spurs nearly as long as the inner. Fore wing with the apex rounded, the termen evenly curved; vein 3 from just before angle of cell; 4, 5 from angle; 6, 7 shortly stalked; 8, 9 stalked; 10, 11 from cell, 11 anastomosing with 12; the retinaculum of male bar-shaped. Hind wing with the cell long; vein 3 from well before angle of cell; 4, 5 from angle; 6, 7 from upper angle, 7 anastomosing with 8.

In key differs from *Calamochrous* in the fore wing having veins 6, 7 stalked and 11 anastomosing with 12.

Calliphlycta metaxantha, sp. n.

Head yellow, the frons white, the antennæ brown ringed with white, the palpi white tinged with yellow and slightly irrorated with brown; thorax white, the tegulæ with their terminal half black, the patagia black at tips and with black spot behind them; abdomen yellow banded with black; pectus, legs, and ventral surface of abdomen white, the fore legs suffused with dark brown, the mid tibiæ with black band at extremity, the abdomen with blackish segmental bands. Fore wing silvery white; the costal area dark cupreous brown to the postmedial band; a black-brown

band near base; a cupreous brown antemedial band with darker edges and line of silvery scales at middle, incurved just below the cell; a cupreous brown postmedial band with darker edges and line of silvery scales at middle, incurved to vein 4, then bent inwards to below end of cell and incurved to inner margin; a cupreous brown subterminal band, arising from apex, its inner edge angled inwards at discal fold and its outer edge dentate to vein 4, confluent with the postmedial band below vein 4, then strongly incurved; cilia with series of black spots to vein 4, then a black line interrupted at submedian fold, the tips with brown mixed. Hind wing yellow with black terminal band to below vein 2; cilia white chequered with black to vein 2, then yellow. Underside of fore wing brown, the inner area white to near tornus; an oblique white subterminal band from costa to vein 6, the termen with the interspaces indented by white marks; hind wing yellow, the costal area white except towards base, a black-brown subterminal band from below costa to below vein 2, its outer edge slightly waved and with the termen white beyond it.

Hab. W. AUSTRALIA, Yallingup (*R. W. Turner*), 1 ♂, 5 ♀ type. *Exp.* 26–28 mm.

(1a) *Liopasia apicenotata*, sp. n.

Head and thorax bright red-brown mixed with some yellowish; abdomen with the two basal segments yellow mixed with fiery red and with subdorsal silvery white spots on basal segment, then grey-brown with dorsal silvery white bar on 3rd segment and the anal segment silvery white, the anal tuft fiery red and yellow; antennæ brown ringed with white; palpi red-brown, white at base; pectus, legs, and ventral surface of abdomen white, the fore tibiae with some red-brown at base and a band at extremity. Fore wing red-brown tinged with grey and irrorated with blackish; some white at base of inner margin; antemedial line black, oblique to submedian fold, then incurved and slightly defined on inner side by yellowish; a small annulus in middle of cell and oblique discoidal lunule defined by blackish; postmedial line dark, oblique to the subterminal line at vein 5, then rather inwardly oblique and slightly waved to vein 2 where it is bent inwards and oblique to inner margin, with small yellow spots beyond it above and below vein 7 and from below vein 3 to inner margin and sometimes slight yellow and red-brown marks before it between veins 5 and 3; subterminal line red-brown, waved, with yellowish-white spots beyond it in the interspaces between veins 8 and 5, separated by red streaks on the veins, and a spot beyond it above vein 2; a red-brown line before termen; cilia yellowish white intersected with brown at the veins and with red-brown line through them, wholly brown between veins 5 and 3. Hind wing semihyaline white, the termen suffused with red-brown to vein 2; a terminal series of dark points except towards tornus.

Ab. 1. Head and thorax with more yellow, abdomen deep fiery red from 3rd to 7th and base of 8th segment; fore wing yellow mixed with some fiery red, the costal area rufous to the postmedial line, no yellow and white spots beyond the postmedial and subterminal lines, the postmedial line more crenulate between veins 5 and 2.

Hab. TRINIDAD (*Jackson*), 2 ♂, 1 ♀ type; VENEZUELA, Palma Sol, 1 ♂, Esteban Valley, Las Quiguas (*Klages*), 1 ♂, 1 ♀. *Exp.* 22-30 mm.

(1b) *Liopasia leucoperalis*, sp. n.

♂. Head and thorax rufous, the latter with some whitish at extremity of patagia and on dorsum; abdomen with the three basal segments silvery white with dorsal rufous streak and segmental lines, then rufous with dorsal and subdorsal silvery white spots on 3rd segment and some white on terminal segments, the anal segment with dorsal and subdorsal silvery white spots and the anal tuft white and rufous; palpi white at base; pectus, legs, and ventral surface of abdomen white, the fore tibiae with red-brown band at extremity. Fore wing rufous, the costal edge white to end of cell, some white at base of inner margin; antemedial line black, oblique to submedian fold, then incurved and with white patch before it on inner margin; a slight black bar in middle of cell, a small round spot at upper angle of cell and minute spot at lower angle; an indistinct wavy red-brown postmedial line, oblique to vein 5 at the subterminal line, then inwardly oblique, with silvery white spots beyond it from costa to vein 5 and from vein 3 to inner margin; a wavy red-brown subterminal line with rather quadrate silvery white spots beyond it above and below vein 7 and a triangular spot below vein 6, separated by rufous streaks on the veins, a rather bidentate spot beyond it above vein 2; a rufous terminal line; cilia silvery white intersected by rufous streaks on the veins, wholly rufous between veins 5 and 3. Hind wing semi-hyaline white, the termen suffused with rufous to vein 3; a faint curved rufous postmedial line from costa to vein 2; a rufous terminal line except towards tornus; cilia white, intersected by rufous at the veins to vein 2.

Hab. PERU, Chaquimayo (*Watkins*), 1 ♂ type. *Exp.* 32 mm.

(5) *Liopasia incoloralis*, sp. n.

♂. Head, thorax, and abdomen white tinged with ochreous and faintly with rufous, the last with diffused blackish bands on 4th to anal segments, the anal tuft with some blackish at extremity; palpi pale rufous, white towards base; pectus, legs, and ventral surface of abdomen white. Fore wing white suffused with pale olive-ochreous, the costal area white to the postmedial line; an oblique olive-ochreous band from below costa before the postmedial line to middle of inner margin; postmedial line rather diffused

olive-ochreous, oblique to vein 6, then rather inwardly oblique. Hind wing pure silvery white.

Hab. BR. E. AFRICA, N. Kavirondo, Maramas Distr., Ilala (*Neave*), 7 ♂ type. *Exp.* 28 mm.

(8a) *Anarmodia glaucescens*, sp. n.

♂. Head, thorax, and abdomen pale red-brown with a greyish tinge; palpi white in front to near extremity of 2nd joint; pectus, legs, and ventral surface of abdomen white mixed with some red-brown, the fore and mid tibiae red-brown, the tibiae with blackish band at extremity, the tarsi with red-brown bands. Fore wing red-brown glossed with grey; a minute faint blackish spot in middle of cell and two slight blackish discoidal points; an indistinct curved red-brown postmedial line; cilia silvery white, red-brown at base. Hind wing silvery white; two slight blackish marks in the cell and a slight black discoidal lunule; the median nervure and veins beyond lower angle of cell streaked with red-brown; postmedial line dark brown, curved and slightly waved, ending at submedian fold; the termen suffused with dark reddish brown, narrowing to tornus; the cilia silvery white with a series of small dark spots at base to vein 2; the inner margin fringed with black-brown hair; the underside with short black streak followed by a point in the cell and small black discoidal lunule, the postmedial line dentate to vein 5, then with blackish points in the interspaces, the termen irrorated with dark brown.

Hab. ECUADOR, R. Pastaza, El Rosario (*Palmer*), 3 ♂ type. *Exp.* 50 mm.

(11) *Anarmodia tesselliferalis*, sp. n.

♂. Head and thorax rufous, the latter with some whitish behind; abdomen red-brown mixed with some whitish and with red-brown segmental lines; antennæ with the basal joint white in front; frons with white lines at sides; palpi deep rufous, white below to extremity of 2nd joint; pectus, legs, and ventral surface of abdomen white, the fore and mid tibiae rufous, the abdomen irrorated with brown. Fore wing rufous, the costal area tinged with whitish, the medial area with the submedian interspace and the interspaces beyond the cell white tessellated with black spots, the terminal area tinged with grey; antemedial line indistinct, dark, oblique; the terminal part of cell with a white fascia with a black spot on it at middle of cell with some rufous scales in centre; a quadrate grey-brown discoidal spot, defined at sides by black; postmedial line formed by blackish scales, slightly sinuous, oblique to vein 7 and incurved below vein 3; the terminal area with some blackish irroration in the interspaces; cilia silvery white, dark brown at base. Hind wing silvery white; a slight brown streak on median nervure and oblique black discoidal striga; postmedial line dark, very slightly dentate, indistinct to vein 5, then blackish

and ending at vein 2; the termen narrowly red-brown except at apex; cilia white with slight blackish spots at the veins to vein 2. Underside of fore wing white, the costal and terminal areas grey-brown, the spots in the cell black, the postmedial line black and dentate; hind wing with the medial area irrorated with some black scales except towards inner margin, especially above end of cell, the postmedial line produced to minute black streaks on the veins, the termen irrorated with blackish except towards apex.

Hab. PERU, Acopampa (*Watkins*), 2 ♂ type. *Exp.* 52 mm.

(1 a) *Bæotarcha microselene*, sp. n.

♀. Head, thorax, and abdomen dark brown with a cupreous gloss; palpi white at base; pectus, legs, and ventral surface of abdomen silvery white. Fore wing dark brown with a cupreous gloss; a faint dark line from origin of vein 2 to inner margin; a slight white discoidal lunule defined by blackish; cilia whitish at tips. Hind wing dark brown with a greyish gloss; a faint dark postmedial line from costa to vein 2; cilia white at tips and the hair on inner margin white; the underside white, the terminal area tinged with brown, a dark postmedial line from costa to discal fold.

Hab. COLOMBIA, Choko Prov., Condoto (*Spurrell*), 1 ♀ type. *Exp.* 22 mm.

(4 c) *Bæotarcha cæruleotincta*, sp. n.

♂. Frons grey-brown with white lines at sides, the vertex of head white mixed with rufous, the antennæ dark brown with white points in front towards base and the basal joint white on outer side, the palpi rufous, white above defined below by blackish; thorax pale red-brown glossed with silvery blue; abdomen pale rufous with some white towards extremity; pectus, legs, and ventral surface of abdomen white, the fore and mid femora suffused with rufous, the fore tibiæ banded with black, the mid tibiæ irrorated with black, the tarsi banded with black. Fore wing semihyaline whitish suffused with red-brown and glossed with silvery blue, the costa and terminal area dark cupreous brown; antemedial line dark brown, oblique; a dark brown discoidal bar; postmedial line brown with minute blackish streaks on the veins, defined on each side by white marks at costa and incurved below vein 3; a white mark on termen at submedian fold; cilia cupreous brown with a fine white line at base to vein 2, then white. Hind wing semihyaline white; a series of black points on termen to vein 3.

Hab. DUTCH N. GUINEA, Mt. Goliath (*Meek*), 1 ♂ type, Snow Mts., Oetakwa R. (*Meek*), 1 ♂. *Exp.* 28 mm.

(2 a) *Calamochrous fulvitinctalis*, sp. n.

Head and thorax fulvous with a yellowish tinge; abdomen with the three basal segments fulvous, white at sides, the 3rd with silvery white band behind expanding rather triangularly on dorsum, the 4th with small dorsal silvery white spot, the 4th to anal segments pale red-brown, the anal tuft white tinged with rufous;

palpi white below towards base; pectus, legs, and ventral surface of abdomen silvery white, the fore tibiæ with brown band at extremity. Fore wing yellow suffused with fulvous, the costal edge pure white, red-brown towards base; antemedial line fulvous brown, very oblique to median nervure, then erect and with clearer yellow before it; a minute fulvous brown spot in the cell towards extremity and small discoidal lunule; a fulvous brown shade beyond the cell between veins 8 and 3; postmedial line rather diffused fulvous brown, slightly incurved from below costa to vein 5, then excurved and waved to vein 3 where it is retracted to the lower edge of the shade and erect to inner margin; a series of minute fulvous spots before termen. Hind wing pure white with a faint yellowish tinge on terminal area except towards tornus.

Hab. ADMIRALTY IS. (*Meek*), 2 ♂, 3 ♀ type; SOLOMON IS., Choiseul I. (*Meek*), 4 ♂. *Exp.* 32–38 mm.

(14d) *Metasia roseociliaris*, sp. n.

♀. Head, thorax, and abdomen white with a faint brownish tinge, the last with the terminal segments tinged with pink; palpi red-brown, white below except at tips; pectus, legs, and ventral surface of abdomen white slightly mixed with brown. Fore wing whitish tinged with pale red-brown, the costa black towards base with some pinkish below it; an indistinct curved red-brown antemedial line; a slight red-brown discoidal striga; postmedial line indistinct, pale red-brown, rather oblique to vein 5, bent outwards between veins 5 and 2, then retracted to below end of cell and slightly excurved to inner margin; a terminal series of slight pale red-brown striæ; cilia tinged with pink. Hind wing whitish tinged with pale red-brown; a dark brown discoidal bar; postmedial line dark brown, slightly excurved to discal fold, bent outwards between veins 5 and 2, then retracted to below end of cell and oblique to inner margin near tornus; a terminal series of slight brown striæ; cilia tinged with pink. Underside tinged with pink, the discoidal lunule with white striga in centre, the postmedial line dark brown.

Hab. BR. C. AFRICA, Mt. Mlanje (*Neave*), 1 ♀ type. *Exp.* 26 mm.

(1a) *Gonopionea biconicalis*, sp. n.

Head and thorax rufous, the latter with a silvery gloss except on tegulæ; abdomen whitish suffused with rufous and with dark brown towards extremity, the genital tufts yellowish white; antennæ ringed with black; sides of frons and maxillary palpi dark red-brown; palpi rufous, white below towards base; pectus, legs, and ventral surface of abdomen silvery white, the fore tibiæ with brown band at extremity. Fore wing rufous glossed with silvery blue; a conical yellow antemedial patch from costa to median nervure, its inner edge angled inwards at costa, defined on inner side by the blackish antemedial line which is obliquely excurved to median nervure and incurved just below the cell, defined on outer side by a blackish line except at costa; a conical yellow postmedial

patch from costa to vein 4, defined at sides by sinuous blackish lines, the blackish postmedial line arising from its apex and strongly incurved; the termen with slight yellow spots from below apex to vein 4 and with some yellow towards tornus; cilia yellow, red-brown at apex and between veins 4 and 3. Hind wing white, the terminal area tinged with red-brown to submedian fold.

Hab. COLOMBIA, Sierra del Libane (*H. H. Smith*), 3 ♂, 1 ♀ type. *Exp.* 22 mm.

(3 a) *Gonopionea flavidalis*, sp. n.

♂. Head, thorax, and abdomen white suffused with pale rufous; palpi rufous, white below towards base; pectus, legs, and ventral surface of abdomen pure white, the fore femora and tibiæ brown on inner side, the anal tuft brown below. Fore wing yellow tinged with rufous, the inner half clear yellow to the medial line; antemedial line brown, oblique, from cell to inner margin; a brown medial line from origin of vein 2 to inner margin, angled outwards below submedian fold; a rather lunulate white patch just beyond the cell with clear yellow above it on costa, the yellow on outer side and the white patch except above defined by a dark brown line; a red-brown terminal line; cilia yellowish white, with some dark brown at apex and dark brown between veins 4 and 2. Hind wing white with a dark red-brown terminal line to submedian fold, above which it forms a diffused wedge-shaped patch on vein 2, then a faint red-brown terminal line to tornus; the underside white with postmedial red-brown line between veins 6 and 5.

♀. Hind wing with the red-brown on termen rather diffused.

Hab. COLOMBIA, Sierra del Libane (*H. H. Smith*), 1 ♂, 1 ♀ type. *Exp.* 26 mm.

(5) *Gonopionea confederalis*, sp. n.

Head, thorax, and abdomen glossy grey-brown; palpi white at base; proboscis white; pectus, legs, and ventral surface of abdomen pure white, the fore tibiæ with black-brown band at extremity. Fore wing glossy grey-brown; antemedial line brown, oblique to submedian fold, then erect; a white bar in upper part of cell towards extremity defined at sides by blackish; a conical yellowish white postmedial patch from costa to vein 5, defined by black and somewhat constricted below costa; a sinuous blackish line from lower angle of cell to inner margin; cilia dark brown, white from below apex to vein 4 and at submedian interspace. Hind wing pale glossy grey-brown, the cilia white at discal fold and towards tornus; the underside white slightly tinged with brown, a brown discoidal bar, the postmedial line brown, excurved to vein 5, then oblique to submedian fold.

Hab. COLOMBIA, Don Amo (*H. H. Smith*), 1 ♂ type, Choko, Juntas del R. Tamana and R. San Juan (*Palmer*), 1 ♀. *Exp.* 16 mm.

[To be continued.]

XX.—New Australian Hymenoptera of the Family Evaniidæ in the British Museum. By ROWLAND E. TURNER, F.Z.S., F.E.S.

Evania sericans, Westw.

Evania sericans, Westw. Trans. Ent. Soc. London, (2) i. p. 215 (1851).

Kieffer places this species in the section of the genus without spines on the hind tibiæ, probably because Westwood makes no mention of such spines; but the spines are really well developed. Though widely spread, the species seems to be uncommon.

Hab. Kuranda, Queensland (*Turner*), May 1913; Mackay, Queensland (*Turner*), March 1892; Victoria (*French*); Yallingup, S.W. Australia (*Turner*), December; Kalamunda, S.W. Australia (*Turner*), February 1914.

Evania perfida, Westw.

Evania perfida, Westw. Trans. Ent. Soc. London, (2) i. p. 216 (1851). ♂.

This is also erroneously placed by Kieffer in the section without spines on the hind tibiæ. Westwood states that his type came from Tasmania, but the specimen marked by him as *perfida* in the British Museum, which is undoubtedly the type, is from S.W. Australia. I have taken it at Yallingup, and it also occurs at Adelaide.

Pseudofænus cylindricus, sp. n.

♀. Nigra, gracillima; mandibulis, apice excepto, testaceis; tibiis macula basali, tarsisque anticis intermediisque pallide flavo-brunneis; terebra, valvulisque apice pallide flavis; alis hyalinis, iridescentibus, venis fuscis, stigmatibus testaceo.
Long. 9 mm.; terebræ long. 1.5 mm.

♀. Second joint of the flagellum short, distinctly shorter than the first, the third half as long again as the second, the flagellum clothed with very short black hairs. Head very long and narrow, about four times as long as broad; the eyes elongate-ovate, separated from the hind margin of the head by a distance about half as great as their length; the anterior ocellus situated well behind a line joining the summit of the eyes; the hind margin of the head not carinate. Neck as long as the distance between the tegulæ and the anterior angle of the mesonotum. Thorax long and narrow, subcylindrical, the mesonotum rounded anteriorly;

parapsidal furrows very shallow and narrow, almost obsolete; scutum much longer than the scutellum; median segment with a longitudinal groove. Head and thorax opaque, without sculpture, the face below the antennæ finely punctured. Petiole 2-jointed, the basal portion formed by the first sternite very slender throughout, the apical portion fully half as long again as the basal, gradually widened towards the apex; second segment about equal in length to the basal portion of the petiole; tergites 2-5 much longer than broad. Terebra scarcely longer than the basal portion of the petiole, slender. Hind tibiæ strongly swollen; hind metatarsus nearly equal in length to the four apical tarsal joints; tarsal unguis small. Wings small and short, not reaching beyond the apex of the second tergite.

The male has the second and first joints of the flagellum equal, the third as long as the first and second combined.

Hab. Kalamunda, S.W. Australia (*Turner*), February 1914. Three females and one male. Easily distinguished by the long narrow head and thorax and short terebra. Not nearly related to the New Zealand group typical of the genus, but nearer to American species such as *angustatus*, Kieff. The species included in *Pseudofænus* by Kieffer seem to fall into two groups, one, including the type of the genus, approaching *Hyptiogaster*, the other much nearer to *Fænus*. The first group is confined to New Zealand.

Pseudofænus fluvialis, sp. n.

♀. Nigra; mandibulis tegulisque testaceis; tibiis macula basali, tibiis anticis apice, tarsis anticis, metatarsisque intermediis posticisque albidis; terebra valvulisque nigris, apice albidis; alis hyalinis, iridescentibus, venis nigris, stigmatibus brunneo; terebra abdomine paulo brevior.

Long. 11 mm.; terebræ long. 6 mm.

♀. First joint of the flagellum very little longer than the second, the two combined distinctly shorter than the third. Head long and narrow; cheeks very short, almost obsolete; head feebly margined posteriorly, narrowed behind the eyes, which are separated from the hind margin of the head by a distance equal to about one-third of their own length. Anterior ocellus situated just in front of the line joining the summits of the eyes. Head and thorax opaque, without sculpture, clypeus finely and closely punctured. Neck as long as the distance between the tegulæ and the front of the mesonotum; parapsidal furrows narrow, but distinct, finely crenulate; mesonotum rounded anteriorly, scutum as

long as the scutellum. Median segment very delicately rugulose, with a low longitudinal carina, hind coxæ finely granulate. Abdomen long and slender, the first tergite twice as long as the second. Hind metatarsus as long as the four apical tarsal joints; tarsal ungues small.

Hab. Perth, W. Australia (*Turner*), February. Two females taken on blossom of *Eucalyptus calophylla* in King's Park.

This is much nearer to the Mexican species, *P. angustatus*, Kieff., than to *P. cylindricus*, but differs in the sculpture of the thorax, the shape of the head, and other details. Kieffer gives two species of *Pseudofænus* as Australian, but *P. unguiculatus*, Westw., is from New Zealand, and *darwinii*, Westw., belongs to *Hyptiogaster*.

Pseudofænus isthmalis, sp. n.

♀. Nigra; mandibulis fuscis; palpis pallidis; tibiis anticis intermediisque supra, metatarsis anticis intermediisque, tarsis anticis articulo secundo, tarsis posticis, basi extrema articuloque apicali nigris, valvulisque terebræ tertio apicali albidis; pleuris sternoque hic illic nigro suffusis, coxis, trochanteribus, femoribusque anticis ferrugineis; tibiis posticis basi infra albo-maculatis; alis hyalinis, leviter suffusis, iridescentibus, stigmatæ venisque nigris; terebra corpore vix brevior.

Long. 10 mm.; terebræ long. 9 mm.

♀. First joint of the flagellum as broad as long, half as long as the second, third fully as long as the first and second combined. Head long and narrow, feebly margined and rather strongly emarginate on the hind margin; front convex, subcarinate longitudinally in the middle; cheeks almost obsolete. Anterior ocellus almost on a level with the summit of the eyes, which are separated from the hind margin of the head by a distance equal to slightly more than one-third of their own length. Head opaque, finely coriaceous. Neck nearly as long as the distance between the tegula and the front of the mesonotum; thorax opaque, very delicately rugulose, mesonotum with the anterior margin straight, only rounded at the angles, with two short impressed longitudinal lines from near the middle of the anterior margin; parapsidal furrows distinct, crenulated; scutum longer than the scutellum, præscutum much longer than the scutum. Median segment with a distinct longitudinal carina, transversely rugulose. First abdominal segment twice as long as the second. Hind metatarsus as long as the four apical tarsal joints; tarsal ungues small.

Hab. Eaglehawk Neck, S.E. Tasmania (*Turner*), February 1913. One female.

Differs from *fluvialis* in the proportion of the antennal joints, the shape of the head, the sculpture of the thorax and median segment, the length of the terebra, in colour, and other details.

Fœnus autumnalis, sp. n.

♀. Nigra; mandibulis apice excepto, tegulis, pedibusque anticis intermediisque ferrugineis; tibiis anticis intermediisque supra, tibiis posticis macula basali, tarsis anticis, tarsis intermediis articulis tribus basalibus, tarsisque posticis, basi apiceque exceptis, albis; terebra, petiolo multo brevior, testacea; valvulis apice albidis, incrassatis; alis hyalinis, venis fuscis; stigmato pallido, fusco-marginato.

Long. 14 mm.; terebræ long. 2.5 mm.

♀. Head opaque, somewhat elongate, slightly swollen behind the eyes, the hind margin distinctly carinate. Eyes separated from the hind margin of the head by a distance equal to about one-third of their own length; posterior ocelli level with the summit of the eyes, twice as far from each other as from the eyes; cheeks very short, not half as long as the first joint of the flagellum; a longitudinal carina between the antennæ. Second joint of the flagellum more than half as long again as the first, the third joint distinctly longer than the first and second combined. Neck short; pronotum with a very short and small spine at each angle; mesonotum opaque, coriaceous, with two very short longitudinal impressed lines from the anterior margin; scutellum with well-defined marginal carinæ; median segment rather coarsely rugose-reticulate, with a rather indistinct median carina; hind coxæ coriaceous. Hind metatarsus no longer than the four apical tarsal joints combined, the basal third black, the apical half of the fifth tarsal joint also black. Terebra scarcely half as long as the petiole.

Hab. Kalamunda, S.W. Australia (*Turner*), March 1914. Four females.

Closely allied to *valvularis*, Schlett., but differs in the lesser development of the angles of the pronotum, in the sculpture of the median segment, and in the shorter cheeks. *F. fuscimanus*, Kieff., has the terebra distinctly longer, the cheeks longer, and the sculpture of the thorax rather stronger; and *F. valens*, Kieff., is a much larger insect, more robust, with the sculpture of the median segment tending to transverse striæ and the coxæ black.

Fœnus exilis, sp. n.

♀. Nigra, minuta; mandibulis tegulisque testaceis; tibiis anticis intermediisque, tibiis posticis basi, tarsis anticis intermediisque, tarsisque posticis subtus pallide brunneis; terebra, petiolo multo brevior, testacea; valvulis apice albidis; alis hyalinis, iridescentibus, venis fuscis, stigmate fusco-ferrugineo.

Long. 7 mm.; terebræ long. 1.5 mm.

♀. Head elongate, opaque, the hind margin very feebly carinate. Eyes separated from the hind margin of the head by a distance equal to half their own length; anterior ocellus situated a little behind a line joining the summit of the eyes; cheeks very short, not as long as the first joint of the flagellum; a low carina running from between the antennæ nearly halfway to the anterior ocellus. First joint of the flagellum scarcely longer than broad, second scarcely half as long again as the first, third distinctly longer than the first and second combined. Neck rather short, angles of the pronotum unarmed; mesonotum opaque, very finely coriaceous, with two short, obscure, longitudinal raised lines from the anterior margin, the curved line separating the præscutum and scutum very shallow and not crenulate. Scutellum without marginal carinæ; median segment irregularly transversely rugulose; hind coxæ very finely coriaceous. Terebra more than half as long as the petiole; hind metatarsus as long as the four apical tarsal joints combined.

Hab. Mt. Wellington, Tasmania, 2200 ft. (*Turner*), January 1913. One female.

This is not nearly allied to the group of *valvularis*, Schlett., having the head slightly narrowed behind the eyes, the scutellum without carinæ, and the groove between the scutum and præscutum narrow and not crenulate.

Fœnus steindachneri, Schlett.

Gasteruption steindachneri, Schlett. Verh. zool.-bot. Ges. Wien, xxxv. p. 300 (1885). ♀.

Hab. Mt. Wellington, Tasmania, 2200 ft. (*Turner*). March.

F. leptotrachelus, Kieff., is very near this, but cannot be the male of this species, having the head much more strongly narrowed behind the eyes.

Fœnus macrocephalus, sp. n.

♀. Maxima, nigra; tibiis anticis intermediisque supra, tarsis

anticis intermediisque apice infuscatis, tarsisque posticis, metatarso tertio basali articuloque quinto exceptis, albidis; terebra, corpore sesqui longiore, testacea, valvulis apice extremo albidis; alis hyalinis.

Long. 30 mm.; terebræ long. 45 mm.

♀. Head opaque, finely coriaceous, massive, slightly swollen behind the eyes, the hind margin rather feebly carinated. Eyes separated from the hind margin of the head by a distance equal to fully half their own length; posterior ocelli in a line with the summit of the eyes, fully half as far again from each other as from the eyes. Cheeks as long as the first joint of the flagellum; a longitudinal carina between the antennæ. Second joint of the flagellum twice as long as the first, third nearly half as long again as the first and second combined. Neck very short; angles of the pronotum unarmed. Thorax opaque, coriaceous, the sides of the præscutum with fine transverse striæ; præscutum nearly twice as long as the scutum, with two short slightly raised lines converging from the anterior margin; the curved line dividing the scutum and præscutum broad and crenulated. Median segment irregularly transversely rugose-striate, with an indistinct median carina; hind coxæ shining, punctured at the base, finely transversely striated at the apex; hind metatarsus about equal in length to the four apical tarsal joints; the fifth joint long, about equal to the second. Pleuræ finely rugose; mesosternum coarsely transversely striated, the sides of the median segment also coarsely striated.

Hab. Victoria (ex coll. *Turner*, received through *C. French*).

This is the largest species of the genus known to me. The head and thorax, especially on the sides, are clothed with very short white pubescence, as in *F. breviscutum*, Kieff. The radius is bent into a sharp angle at about two-thirds from its base, as in all the group of *breviscutum*.

Fœnus calothecus, Kieff.

Gasteruption calothecus, Kieff. Ann. Soc. Ent. France, lxxx. p. 198 (1911). ♀.

Specimens of this species from Yallingup, S.W. Australia, are larger than the type, measuring up to 22 mm., with the terebra 60 mm., but do not seem to differ appreciably in colour or structure. The type is from Queensland; the cotype has been labelled Mexico, evidently by mistake.

Fœnus bicarinatus, sp. n.

♀. Nigra; mandibulis basi, pedibusque anticis fusco-ferrugineis; tibiis anticis intermediisque supra, tarsis anticis intermediisque apice infuscatis, tarsisque posticis, metatarsi tertio basali articuloque quinto exceptis, albidis; terebra rufo-testacea abdomine paullo longiore, valvulis apice flavidulis et dilatatis.

Long. 22 mm.; terebræ long. 15 mm.

♀. Head not very strongly narrowed behind the eyes, slightly swollen transversely behind the ocelli, opaque and coriaceous, the hind margin distinctly carinated. Eyes separated from the hind margin of the head by a distance equal to nearly half their own length; posterior ocelli in a line with the summit of the eyes, twice as far from each other as from the eyes. Cheeks half as long again as the first joint of the flagellum, a longitudinal carina between the antennæ, the front depressed on each side above the base of the antennæ; second joint of the flagellum twice as long as the first, third more than half as long again as the first and second combined. Neck rather short; angles of the pronotum almost unarmed. Mesonotum irregularly transversely rugose-striate; with two longitudinal carinæ from near the middle of the anterior margin not reaching the middle of the præscutum, the space between the carinæ transversely striated and deeply depressed. Pleuræ rugose; median segment rather coarsely rugose, convex, with a longitudinal carina, the sides of the segment above the hind coxæ with a few coarse striæ. Hind coxæ shining, rather indistinctly transversely striated. Hind metatarsus as long as the four apical tarsal joints combined. Radius sharply bent upwards towards the costa at about two-thirds from the base, as in *breviscutum* and other allied species.

Hab. Swan River, Western Australia.

Easily distinguished by the strong carinæ on the mesonotum.

2022 XXI.—A revised Classification of the Otomyinæ, with Descriptions of new Genera and Species. By OLDFIELD THOMAS.

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THE very striking cranial and dental characters found among the different species of what has hitherto been considered the single genus *Otomys*, have long seemed to indicate that some subdivision of the genus would be advisable.

In Mr. Wroughton's admirable monograph of *Otomys**, the characters used are almost entirely dental, little attention being paid to the skull. Now, however, taking cranial characters into full consideration, I find that the group appears to be divisible into three genera, as shown below.

Although not easily defined in a key, the general shape of the skull is quite distinctive of the three genera, and is, I consider, the best indication of their relationships. On the other hand, the grooves on the incisors, and the numbers of the molar laminae, used so effectively by Wroughton and Dollman for the sorting of the species, are so plastic, and show so wide a range of variation, that, however useful for specific distinction, they have to be used with great caution when generic divisions are in question.

On this account, while distinguishing as full genera the obviously natural groups typified by *O. brantsii* and *O. unisulcatus*, I have thought it better only to consider those represented by *O. anchietæ* and *laminatus* as subgenera of *Otomys*, their distinction being almost entirely based on the plastic dental characters. And the same with *Parotomys brantsii* and *littledalei*.

- | | |
|---|-----------------------------------|
| A. Nasals not excessively expanded anteriorly. Tendency to grooving of incisors and extra lamination of molars less; lower incisors not or very faintly grooved; m^3 with 4 or, at most, 5 laminae. | |
| a. Bullæ very large. No special nasal broadening. M^3 composed of two complete laminae and a modified posterior portion | 1. <i>Parotomys</i> , g. n. |
| a^2 . Upper incisors grooved | 1 a. <i>Parotomys</i> , s. s. |
| b^2 . Upper incisors smooth | 1 b. <i>Liotomys</i> , subg. n. |
| b. Bullæ normal. A slight nasal broadening. M^3 composed of three complete laminae and a posterior trefoil | 2. <i>Myotomys</i> , g. n. |
| B. Nasals excessively broadened anteriorly, the premaxillæ outside them not or scarcely visible from above. Tendency to grooving of incisors and extra lamination of molars at a maximum; lower incisors, as well as upper, deeply grooved; m^3 with 6 laminae or more† | |
| c. M_1 composed of 4 laminae | 3. <i>Otomys</i> . |
| d. M_1 with more than 4 laminae. | 3 a. <i>Otomys</i> , s. s. |
| c^2 . M_1 with 5 laminae, m^3 with 7 | 3 b. <i>Anchotomys</i> , subg. n. |
| d^2 . M_1 with 6-7 laminae, m^3 with 9-10 | 3 c. <i>Lamotomys</i> , subg. n. |

* Ann. & Mag. N. H. (7) xviii. p. 264 (1906). See also Dollman's paper on the East African forms, *op. cit.* (8) xv. p. 149 (1915).

† Five in *O. denti*.

1. PAROTOMYS*, gen. nov.

Genotype. *B. brantsii* (*Otomys brantsii*, Smith).

Skull short, high, considerably bowed. Its general shape showing no trace of the characteristic form found in typical *Otomys*. Muzzle narrow, the nasals not particularly broadened anteriorly. Interorbital region not specially contracted, its edges with well-marked thickened beads and postorbital projections. Interparietal nearly as long as broad. Bullæ very large; meatus with a strongly projecting thickened collar on its anterior edge prominently visible from above; the meatal greater than the zygomatic breadth of the skull.

Teeth. Upper incisors with either one distinct and one indistinct groove (*Parotomys*, s. s.), or with none at all (subgenus *Liotomys*). Lower incisors without any trace of grooves.

Third upper molar with four laminal elements, the posterior ones somewhat modified. Front lower molar also with four, the two anterior partially coalesced.

This genus is most distinct from the other *Otomyinæ*, no forms being known at all intermediate in either skull or tooth characters. It may again be subdivided into two, as follows:—

1 a. PAROTOMYS, s. s.

Upper incisors with one distinct outer and one indistinct inner groove. Zygomatic plate evenly convex anteriorly. Palatal foramina short. Bullæ nearly spherical.

Genotype as above.

1 b. LIOTOMYS†, subgen. nov.

Upper incisors quite without grooves, like the lower. Zygomatic plate more or less cut back anteriorly. Palatal foramina of medium length. Bullæ more or less oval.

Genotype:—

Parotomys (*Liotomys*) *littledalei*, sp. n.

Size and general appearance as in *P. brantsii*. Colour very much as in the typical (Namaqualand) race of that species, though slightly darker, and so verging towards that of *P. b. luteolus*. The back rather darker than "cinnamon-buff," the sides and belly paler buff, the hairs very broadly

* παρά, beside + *Otomys*.

† λείος + *Otomys*.

slaty basally. Hands and feet buffy white. Tail apparently longer than in *brantsii*, though satisfactory measurements are not available; well haired, dark buffy above, paler below, a variable portion of the upper side of the end of the tail brown or blackish, but this is sometimes scarcely perceptible.

Skull and teeth as indicated in the synopsis and subgeneric diagnoses above.

Dimensions of the type:—

Head and body 157 mm.; tail 97; hind foot 26.

Skull: greatest length 37.6; condylo-incisive length 36; zygomatic breadth 20; nasals 12.8×4.2 ; interorbital breadth 6; meatal breadth 21.5; palatilar length 17; palatal foramina 7; bullæ 12.3×8 ; upper molar series (crowns) 7.2.

Hab. Bushmanland. Type from Tuin, Kenhart.

Type. Old male. B.M. no. 12.4.25.9. Original number 7. Collected 16th July, 1911, by Maj. H. A. P. Littledale. Five specimens.

The specimens of this remarkable animal were placed with the collection of *Otomys brantsii* without examination of the skulls, which were cleaned and put away later. Now, however, study of the skulls shows that Major Littledale's animal is wholly different, and represents a really interesting discovery.

2. *MYOTOMYS**, gen. nov.

Genotype. *M. unisulcatus* (*Otomys unisulcatus*, Bts.).

Skull with more indication of an approach to that of *Otomys*. But the muzzle is not modified in the peculiar way characteristic of that genus, the nasals being but little broadened anteriorly, so that the premaxillæ are always clearly visible from above outside them. Interorbital region not specially contracted; its edges with distinct beads, which evenly diverge backwards instead of abruptly curving outwards to form postorbital projections, as is the case in *Otomys*. These beads scarcely run any distance on to the parietals. Other skull-characters much as in *Otomys*.

Teeth not very highly specialized. Upper incisors generally with one narrow groove, which is, however, occasionally obsolescent. Lower incisors not or very faintly grooved. Third upper molar not greatly laminated, the usual condition being three complete laminae and a posterior trefoil, which

* $\mu\upsilon\varsigma + Otomys$.

may in some cases represent two laminal elements; the total therefore usually four and never more than five. First lower molar composed of four laminae or their equivalents, as in *Otomys*.

This genus, although clearly worthy of being distinguished as such, shows more relationship to *Otomys* than is the case with *Parotomys*. One species, indeed, *M. turneri*, both has more expanded nasals than is normal and has clearly five laminae in its m^3 ; but even then there is no equality with the specialized condition found in true *Otomys*, and the frontal ridges are quite as in *Parotomys*, not as in *Otomys*.

The following forms belong to this genus :—

broomi, Thos.
granti, Thos.
sloggetti, Thos.
turneri, Wrought.
unisulcatus, Bts.

3. *Otomys*, F. Cuv.

Genotype. *O. irroratus*, Bts.

Skull highly specialized. Muzzle with an exaggerated expansion of the nasals in their anterior half, where they are bent down laterally, and quite hide the premaxillae from above. Interorbital region contracted, its edges with high ridges, which posteriorly turn abruptly outward to form postorbital processes, and then run backwards across the parietals.

Teeth. Incisors much grooved, the upper with one well-defined groove just outside the middle, the lower with one broad and deep outer groove and on the inner side either the faint indication of a second groove, a shallow but distinct groove, or a deep and distinct second groove, all stages between the three being present.

Molars with great tendency to extra lamination, the third upper molar with from six to ten laminae (five in *O. denti* only) and the first lower with from four to seven.

It does not appear possible to separate satisfactorily the species with two grooves on the lower incisors (*typus* and its allies *) from the ordinary *Otomys* with only one, as the intergradation in the depth and conspicuousness of the grooves is too complete. On the other hand, two species, *anchietæ* and *laminatus*, show such differences in the number of the molar laminae that I have thought they should be

* Representing *Oreinomys*, Trouess.

subgenerically separated, thus making three subgenera, as follows :—

3 a. OTOMYS, s. s.

Genotype. *O. irroratus*, Bts.

First lower molar with four laminae ; last upper with 5 to 8.

3 b. ANCHOTOMYS *, subgen. nov.

Genotype and only species. *O. anchietae*, Boc.

First lower molar with five laminae ; last upper with seven.

3 c. LAMOTOMYS †, subgen. nov.

Genotype and only species. *O. laminatus*, Thos. & Schw.

First lower molar with 6-7 laminae ; last upper with 9-10.

Otomys contains the great mass of the species of the group, and has by far the largest range, extending from the Cape to Abyssinia, while the other two genera are both confined to South Africa.

The following new forms of this genus appear to need description :—

Otomys irroratus cœnosus, subsp. n.

Size averaging very large, the skull-length of large specimens greater than in any other *Otomys*.

Colour a dark muddy greyish, darker than in *O. i. auratus*, greyer, especially on the sides and rump, than in true *irroratus*.

Skull as in true *irroratus*, but averaging larger. Laminae of m^3 always 6 in number.

Dimensions of the type (measured in the flesh) :—

Head and body 201 mm. ; tail 125 ; hind foot 32·7 ; ear 23·5.

Skull : greatest length 46·3 ; condylo-incisive length 43·5 ; zygomatic breadth 23·2 ; nasals 20·5 × 9·2 ; interorbital breadth 4 ; upper molar series 9·2.

Hab. Kuruman, Bechuanaland. Alt. 4000'.

Type. Adult male. B.M. no. 4. 4. 8. 13. Original number 20. Collected 14th February, 1904, by R. B. Woosnam. Seven specimens.

By their great average size and muddy-grey colour these *Otomys* seem distinguishable from the ordinary *O. irroratus*,

* ἄγχι, near + *Otomys*.

† λάμος, the maw (also voraciousness) + *Otomys*.

although isolated individuals from elsewhere may be nearly as large. The skull of the type even exceeds in length, though not in bulk, that of the large *O. (Anchotomys) anchietæ* of Angola.

Otomys rowleyi, sp. n.

Like *O. irroratus* superficially, but apparently really a representative in Portuguese S.E. Africa of the 7-laminated forms of the Zambesi and northwards.

General appearance and colour quite as in *O. irroratus cupreus*, but the fur shorter and coarser. Ears and tail not very heavily furred.

Skull of medium size, about equalling that of *O. irroratus*. Nasals differing from those of other S. African forms by their even expansion anteriorly, and the absence of a definite angle at the point where the narrow part passes into the broad—this character quite uniform in the one adult and four young specimens before me. All the other S. African forms have a marked angle at the point referred to.

Teeth. Third upper molar with seven laminae in every specimen, this number being that characteristic of the Zambesi and more northward *Otomys*, only rarely and exceptionally occurring in *O. irroratus*.

Dimensions of the type (measured in the flesh) :—

Head and body 167 mm. ; tail 92 ; hind foot 27 ; ear 20.

Skull : greatest length 40 ; condylo-incisive length 37·7 ; zygomatic breadth 19·7 ; nasals $18 \times 7\cdot4$; upper molar series 9·1.

Hab. Coguno, Inhambane, Portuguese S.E. Africa.

Type. Adult female. B.M. no. 6.11.8.77. Original number 1585. Collected 31st July, 1906, by C. H. B. Grant. Presented by Mr. C. D. Rudd.

Accidentally overlooking the fact that one of the series was fully adult, Mr. Wroughton and I provisionally referred this animal in 1906 to *O. irroratus cupreus*, but I now consider that its constant possession of seven laminae in m^1 indicates that it is a southern representative in the low hot coast-lands of the more northern forms characterised by that number of laminae, while only six is usual in *irroratus*. The absence of an angular corner halfway along the lateral nasal sutures is also a character which affines it to some of the more northern forms and distinguishes it from *O. irroratus*.

It is named in honour of Mr. F. R. Rowley, Curator of the Royal Albert Memorial Museum at Exeter, to whom both officially and privately the Mammal Department of the National Museum is greatly indebted for assistance.

Otomys mashona, sp. n.

Most nearly allied to *O. angoniensis*, but greyer and with differently shaped nasals.

Size about as in *angoniensis* or a little smaller. Fur decidedly finer and softer than in that species. General colour very much as in *O. irroratus auratus* or a shade darker, greyer and less brownish than in *angoniensis*; sides and hips distinctly greyer.

Skull with the nasals shorter and proportionately broader than in *angoniensis*, the broad anterior part shorter and the posterior part more rapidly narrowing backwards; lateral sutures without a marked angle, this character distinguishing the species from *irroratus*.

Third upper molar normally with seven laminae.

Dimensions of the type (measured in the flesh):—

Head and body 171 mm.; tail 108; hind feet 30.

Skull: greatest length 41; condylo-incisive length 39; zygomatic breadth 20·3; nasals 17×8·9; interorbital breadth 4·3; height from supraorbital edge to alveolus of m^2 13·7; palatilar length 19; upper molar series 9·2.

Hab. Mazoe, Mashonaland, Southern Rhodesia. Alt. 4000'.

Type. Adult male. B.M. no. 95.11.3.13. Original number 44 B. Collected 5th August, 1895, and presented by J. ffolliott Darling.

This *Otomys* was identified by Mr. Wroughton with *O. irroratus auratus* of Vredefort Road, Orange River Colony, a locality very much farther south, but I venture to think it is more related to *angoniensis* and *rowleyi*, with which it agrees in the number of its molar laminae and its non-angular nasal sutures.

Otomys burtoni, sp. n.

A small species, isolated in the Cameroons.

Size comparatively small. Fur very long and soft, woolly hairs of back about 20 mm. in length. General colour dull grizzled brown with a slight coppery tint, very much as in *O. irroratus cupreus*. Hands and feet dark brown.

Skull not strongly bowed, with rather short muzzle. Nasals of medium broadening anteriorly, the lateral sutures not strongly angular. Interorbital region not heavily ridged.

Upper incisors more pointed backwards than is usual even in this opisthodont genus, the angle (50°) lower than in any

other rodent I have measured; their face with the usual deep outer and obsolescent inner groove. Lower incisors with one broad and partially doubled external groove and the usual obsolescent inner one.

Dimensions of the type (measured on the dry skin):—

Head and body 158 mm.; tail 75; hind foot 26; ear 20.

Skull: tip of nasals to back of frontals 27·5; zygomatic breadth 18·5; nasals 16·5 × 7·5; interorbital breadth 4·1; breadth of brain-case 14·5; height of supraorbital edge from alveolus of m^2 11·6; palatilar length 16·3; diastema 8·5; upper molar series 8·2.

Hab. Cameroons Mountains. Alt. 7000'.

Type. Old female. B.M. no. 7.1.1.196. Collected by "Capt. Burton, H.M. Consul of Fernando Po," later Sir Richard Burton. Received with the collection of Mr. R. F. Tomes.

This Cameroons *Otomys*, widely isolated as it is geographically from all other members of the genus, seems to be most nearly allied to certain of the Central African species, among which, by Dollman's synopsis, it comes closest to *O. tropicalis nubilis* of the Mount Kenya region. It is, however, conspicuously smaller than that animal, nor can I find any other to which it could be assigned.

I have named it in honour of its famous collector, Sir Richard Burton, to whose ability and energies as a naturalist too little credit has been generally given.

XXII.—*The Hedgehog of Palestine and Asia Minor.*

By OLDFIELD THOMAS.

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WHEN writing his paper on the subspecies of *Erinaceus europæus* * Barrett Hamilton referred five specimens in the British Museum from Mount Lebanon to *Erinaceus concolor*, Martin, described from Trebizond. The type of the latter being wholly black it seemed abnormal, and on this account Barrett Hamilton could not distinguish the Mt. Lebanon specimens from it.

Since that date, however, further knowledge and further material bearing on the question of *E. concolor* has accrued. Miller has shown the definite distinction of *E. roumanicus*

* Ann. & Mag. N. H. (7) v. p. 360 (1900).

and the forms related to it from *E. europæus* and its allies. This distinction rests mainly in the greater extension in the former of the maxillary bones, which reach further back, so as to coincide almost exactly with the muscular fossa* of this region. In *europæus*, on the other hand, the fronto-maxillary suture traverses the fossa a marked distance in front of its hinder limit.

Examination of the typical skull of *E. concolor* now shows that its structure is as in *E. europæus*, not as in *E. roumanicus*, and it therefore agrees with certain other forms of this character which Satunin has shown to occur in Transcaucasia, so that it cannot be looked upon in any way as abnormal. Moreover, the same author has described a dark "*E. ponticus*" and a black "*E. ponticus abasgicus*" from the eastern shores of the Black Sea, which would show that a naturally black hedgehog does occur in this region. Probably Satunin's animals are, one or both, referable to *E. concolor*.

This being the case, it is evident that the Palestine and Asia Minor hedgehog, which belongs to the *roumanicus* type, only needs comparison with the last-named species, of which it may be considered a subspecies, as follows:—

Erinaceus roumanicus sacer, subsp. n.

General colour brown, about as in *E. europæus*, the head not blackened. Spines with one subterminal dark band. Fur of face, chest, and fore-limbs with a considerable mixture of white hairs, that of the sides and belly uniformly brown.

Skull, on the whole, like that of *roumanicus*, but distinguished by the much greater length and development of the lacrymal crests, which in that animal are reduced to a mere projecting knob above the lacrymal foramen, but in the new form are as long as in *E. europæus*, running back quite to the hinder corner of the muscular fossa above referred to, and being traceable further back still as a ridge across the frontals. Transverse occipital crest relatively higher, projecting above the level of the brain-case.

Dimensions of type:—

Hind foot (c.) 39 mm.

Skull: condylo-basal length 60; zygomatic breadth 37·5; nasals 19·5 × 4; premaxillo-nasal suture 11; maxillo-nasal suture 2·5; distance from posterior end of premaxillæ to upper hinder corner of maxillæ 11·5; interorbital breadth 17;

* Apparently, judging from Dobson, that of the upper half of the *levator labii superioris proprius*.

intertemporal breadth 14·7; palatal length 33·3; upper tooth-row 31.

Hab. Palestine and Asia Minor. Type from near Jerusalem.

Type. Adult female with worn teeth. B.M. no. 18. 8. 1. 2. Collected May 1918 during the British campaign, and presented by Capt. Guy C. Shortridge.

Of this hedgehog the Museum contains five specimens, with imperfect skulls, from Mt. Lebanon, presented by Saleem Baroodi, a fine old female from Tortoum near Erzeroum, collected by R. B. Woosnam, and another from Kara Dagħ near Konia, presented by L. Ramsay, in addition to the present specimen (the type). I have thought it wise to select as type a specimen from the farthest southern known extension of the group—that is, of the restricted genus *Erinaceus*,—the hedgehogs from further south and east being referable to *Hemiechinus*.

XXIII.—*On a new Jumping Mite of the Genus Nanorchestes from the Mendip Hills.* By STANLEY HIRST.

THE mite dealt with in the present note is of interest, owing to the fact that the only species of the genus hitherto described (viz. *Nanorchestes amphibius*, Topsent & Trouessart) lives on the sea-shore, between the tide limits or slightly above them. This littoral species was discovered by M. Topsent at Luc-sur-Mer (Calvados), France, and afterwards found by the author at St. Catherine's Point, Isle of Wight. The new species described below has a very different habitat, for it lives on the summit of the Mendip Hills at an altitude of over 800 feet and more than eight miles from the sea-coast.

Nanorchestes collinus, sp. n.

General appearance very like *N. amphibius*, Tops. & Trouess., but smaller in size. Hairs on dorsal surface of cephalothorax also very similar. The curious unpaired median structure between the chelicerae is present and strongly curved. This new species differs from *N. amphibius* in the following details of structure:—Dorsal hair on chelicera slender and dividing close to the base into two plumose branches, the outer one being considerably longer than the

other (whereas in *N. amphibius* the dorsal hair is rather stout, stiff, rod-like, and not divided). Hairs on abdomen very similar to those of *N. amphibius*, being short and branched in the same way, but they are finer. The sac-like structure placed immediately behind the eye is almost circular (instead of being rather elongate-oval).

Length (slightly pressed by accident) 240 μ .

Material. A single specimen collected by the author on the summit of the Mendip Hills, near Axebridge, Somerset, July 1918.

XXIV.—*On some External Characters of Ruminant Artiodactyla*.—Part III. *The Bubalinæ and Oryginæ*. By R. I. Pocock, F.R.S.

PARTS I. and II. of this series, supplementing my paper published in the Proc. Zool. Soc. for 1910, appeared in the Ann. & Mag. Nat. Hist. for June and August of this year. As in those papers, the reference numbers inserted after the genera and species in the following pages apply to the treatise issued in 1910.

Subfamily *BUBALINÆ*.

Genus *DAMALISCUS*, Scl. & Thos.

In 1910 I described the preorbital and pedal glands of this genus from dried skins of *D. korrigum*. I am now able to supplement that account from fresh material of two South African species, *D. albifrons* and *D. pygargus*.

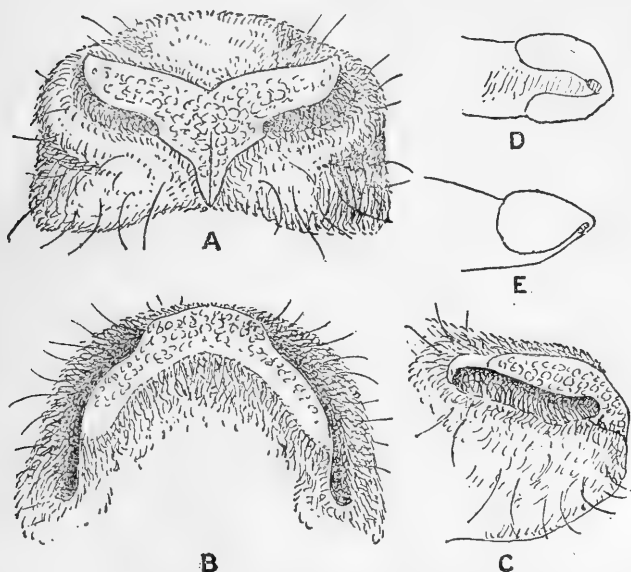
Damaliscus albifrons, Burch.

The muzzle (fig. 1, A, B, C) is long, broad, and depressed, with mobile upper lip and fleshy, valvular, narrow, and elongate nostrils, lined for some distance inside, both above and below, with hair. The *rhinarium* is much reduced, but is broad between the narrowed inner ends of the nostrils; beneath the septum it is continued down the upper lip as a short mesially grooved philtrum, which rapidly narrows from its wide base to its pointed lower end which reaches the inferior edge of the upper lip. Dorsally it extends as a moist band along the upper lid of the nostril, but falls short of the posterior angle of the nostril by some distance; on the lower lid of the nostril there is no rhinarial extension

of moist skin. From the dorsal aspect the rhinarium appears as a crescentic band, thicker mesially in front than posteriorly at the sides, the hairs on the upper side of the muzzle spreading far forwards between the nostrils, forming a well-defined field with an evenly convex antero-lateral edge. The surface of the rhinarium is covered with a reticulation of grooves defining low rounded eminences.

The *preorbital gland* is marked externally by a slightly

Fig. 1.



- A. Muzzle and rhinarium of *Damaliscus albifrons* from the front. $\times \frac{1}{3}$.
- B. The same from above.
- C. The same from the side.
- D. Extremity of the penis of *D. pygargus* from below.
- E. The same from the right side.

raised circular naked area, with a central orifice leading into a short cylindrical tube penetrating about halfway into the substance of the thick gland.

Inguinal glands are absent, and there is a single pair of mammæ.

The *pedal glands*, like those of other Bubalines I have already described, are well developed only on the fore feet, where they consist of a deep and long interdigital pouch overlapped to a great extent above by the folded integument'

of the pastern, but with a comparatively long slit-like orifice. On the hind foot the gland is represented merely by a shallow naked depression.

Damaliscus pygargus, Pall.

Differs in none of the particulars described above from *D. albifrons*, except that the philtrum fails to reach the edge of the upper lip.

In the male the *penis* (fig. 1, D, E) ends in a well-defined cordate thickening, broad at the base, narrowed at the apex. The urethral canal is not produced beyond the extremity of the glans, but terminates in a groove in the middle of its under side.

The figure of the penis of *D. albifrons*, published by Garrod (P. Z. S. 1877, p. 11, fig. 22), and apparently copied by Gerhardt, represents this organ as apically attenuated and provided with a short tubular urethral process lying along the left side of the end of the glans and free from it to a very limited extent, but not projecting beyond it.

It seems to me to be very unlikely that two species so closely allied as *D. albifrons* and *D. pygargus* differ in reality in the structure of the penis to the extent indicated by Garrod's observations and my own; and since Garrod's figure shows close agreement between the penis of *D. albifrons* and that of *Connachates*, I am disposed to think it likely that the penis of *D. pygargus* I examined must have been abnormal or, perhaps, mutilated with respect to the end of the urethra.

There the matter must rest until the opportunity of examining this organ in other examples of *D. pygargus* occurs. Considering the rarity of the species we may have to wait long for such a chance to verify or disprove the point at issue.

Genus CONNOCHÆTES, Licht.

Connachates gnou, Zimm. (p. 904).

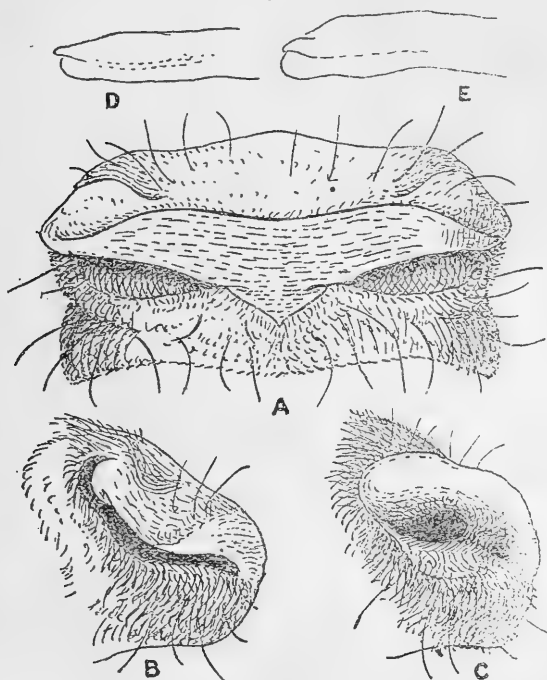
I have very little to add to my original account of this species except some facts regarding the rhinarium and penis which were not described in 1910*.

The muzzle (fig. 2; A, B, C) is a gross exaggeration of the type seen in *Damaliscus*, being wider and having the valvular lids of the nostrils more protuberant and fleshy.

* In one specimen the surface of the preorbital gland showed a central saucer-like depression. Hence this surface is not always flat, as described in 1910.

A further important and very interesting difference is the presence of a well-developed pouch, lined with short hair, penetrating the internarial septum on each side and opening by a circular orifice within the anterior angle of the nostril, nearly midway between the latter and the anterior end of entrance to the narial passages. The orifice of this pouch,

Fig. 2.



- A. Muzzle and rhinarium of *Connocætes gnou* from the front. $\times \frac{1}{3}$.
(The vibrissæ shorter than in nature.)
- B. The same from the side.
- C. The same with the upper lid of the nostril raised to show the orifice of the sack penetrating the septum.
- D. Extremity of penis of the same from below.
- E. The same of *Gorgon taurinus* from the left side.

like the entrance to the chamber itself, is revealed when the upper lid of the nostril is raised and concealed when it is in its normal depressed position (fig. 2, B, C).

Owing to the scanty clothing of hair on the dorsal side of the muzzle, the *rhinarium* is not so well defined above and behind as in *Damaliscus*; it extends less than halfway

round the upper lid of the nostril. Viewed from the front it is exceedingly wide and laterally attenuated, with a concavo-convex, sinuous upper edge. The philtrum, which is broad, angular, and ungrooved, is inferiorly abbreviated, ending in a point a little above the middle of the upper lip, the lower portion of which is continuously hairy across the middle line. The surface of the rhinarium is transversely striated, not roughened and tessellated.

In his paper on the anatomy of the Gnu, Lönnberg (K. Vet.-Akad. Handl. xxxv. no. 3, p. 48, 1901) paid no special attention to the rhinarium, contenting himself with a reference to the descriptions published by others, notably by Selater and Thomas in the 'Book of Antelopes,' vol. i. This brief description, however, contains no mention of the pouches in the internarial septum, because they are completely concealed in dried skins. No doubt this fact accounts for their having hitherto apparently escaped detection. At all events I have not come across any record of their occurrence.

I am unable to suggest any explanation of the function of these pouches, unless they act as traps for the maggots of parasitic dipterous insects (*Æstrus*) whose usual habit it is to pass up the true nostril into the narial passages, where they frequently set up serious disorders in Ruminants. At all events, these parasites would be innocuous in the pouches.

The *penis* (fig. 2, D) differs from that of *Damaliscus pygargus* in being apically attenuated, without trace of the cordate thickening at the end, and in the termination of the urethral canal in a short process on the left side of the apex, beyond which it projects for a very short distance.

Genus GORGON, Gray.

Gorgon taurinus, Burch. (p. 906).

An example of *G. taurinus albojubatus*, four and a half months old, had the muzzle constructed as in *Connochætes gnou*, except that the peculiarities were less exaggerated; it was less depressed and narrower and the rhinarium seen from the front was deeper from above downwards and the shortened philtrum showed a narrow groove.

The *preorbital gland* was scantily clothed with long hair and its surface was mesially depressed and saucer-like.

The *penis* (fig. 2, E) of an adult male of the typical race was less attenuated apically than in that of *Connochætes gnou* and the urethral canal was not prolonged beyond the end of the glans.

From evidence supplied mainly by the digestive tract,

Lönnberg (K. Vet.-Akad. Handl. xxxv. no. 3 (1901); Arkiv. Zool. v. no. 10, p. 21 (1909)) was of opinion that the Gnus are phylogenetically related to the Bovinæ, the latter being the descendants of antelopes closely akin to *Connochætes* and *Gorgon*. It appears to me, however, to be certain that the Gnus must be regarded as highly specialised forms of *Bubalis*; but I cannot admit that the latter are in any way nearly affiliated to any form of Bubalinæ. The evidence, on the other hand, that the Bovinæ are specialised Tragelaphinæ is, in my opinion, complete.

The usually recorded differences between the Gnus and Hartebeests in cranial and cornual characters are well known. Using the muzzle as a basis the two groups may be distinguished as follows :—

- | | |
|---|---|
| <p>a. Muzzle comparatively narrow; rhinarium cleaving the upper lip approximately to its inferior edge, its depth about half its width, its surface roughened and reticulated; no pouches in the internarial septum within the nostril</p> <p>a'. Muzzle comparatively very broad; rhinarium not extending to inferior edge of upper lip, its depth less than half its width, its surface transversely striated; a pair of pouches penetrating the internarial septum within the nostrils</p> | <p><i>Bubalis, Damaliscus.</i></p> <p><i>Connochætes, Gorgon.</i></p> |
|---|---|

The Bubalinæ constitute a compact group of Bovidæ, showing comparatively slight range of variation so far as the external features dealt with in this paper are concerned. The muzzle is expanded, the rhinarium is reduced, the nostrils are valvular and lined within the orifice with longish hair for the exclusion of foreign bodies. The preorbital gland is large and is either provided with a narrow duct-like invagination (*Damaliscus, Bubalis*) or has a flat, slightly convex or slightly concave surface (*Connochætes, Gorgon*). Inguinal glands are absent, and there is normally, at all events, a single pair of mammæ. Pedal glands are well developed only on the fore feet, where they consist of a long deep interdigital pouch with a long orifice, but not so long as in the Antilopinæ, on the front of the pastern. In the hind feet this gland is aborted and represented merely by a shallow depression. The penis at most has a short tubular urethral prolongation.

Subfamily ORYGINÆ.

Genus ORYX, Blainville.

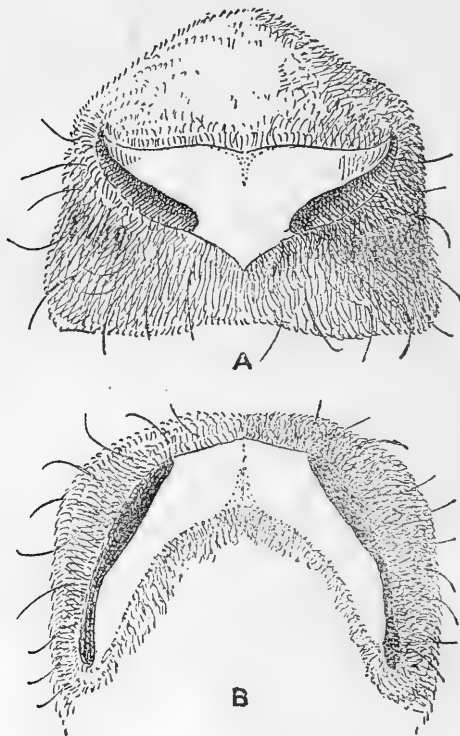
My account of the cutaneous glands of this genus published in 1910 was based upon an examination of dried skins

and living animals only. Since that date I have had the opportunity of seeing fresh carcasses of two very distinct species, namely *O. gazella*, the type of the genus, and *O. leucoryx*, which should rank, I think, as a distinct genus

Oryx gazella, Linn.

The muzzle (fig. 3, A, B, and 4, F) is broad and depressed,

Fig. 3.



A. Muzzle of rhinarium of *Oryx gazella* from the front. $\times \frac{1}{3}$.
B. The same from above.

with the nostrils narrow, elongated, valvular, and hairy right up to their lower rim. The smooth rhinarium is reduced in size, moderately broad between the nostrils, and extending laterally as a comparatively narrow strip all along the upper rim of the nostrils. From the dorsal aspect it is crescentic, the hairs of the dorsal side of the face extending

far forwards between the nostrils, more than halfway along their length, forming a field with an evenly convex antero-lateral border. From the front the upper edge has a sinuous curvature, and the depth of the rhinarium down the middle line is about equal to the width of the internarial septum; the inferior edge is slightly angled, but is not continued as a philtrum down the upper lip, which is continuously hairy across the middle line*.

Preorbital and *inguinal glands* are absent, as Owen and Ogilby correctly recorded.

The *pedal glands* on all four feet consist of dilated hair-lined pouches, opening by a narrow passage and a small orifice on the front of the pastern just above the summit of the folded interungual web. They resemble those of *O. beisa* described in 1910, except that the orifice is small and sub-circular (cf. *infra*).

Oryx beisa, Rupp. (p. 907).

I am indebted to the late Mr. F. C. Selous for the fore and hind foot of an adult example of this species from British East Africa. In these the glands were moderately large and saccular, with a narrow cylindrical exit passage and circular orifice. In 1910 I described the orifice of the gland observed on the dried feet of an immature specimen as consisting of an elongated slit. The shape assumed by the orifice in this case was probably due to shrinkage of the skin when drying. At all events, the glands of the specimen brought for me by Mr. Selous resembled those of the fresh specimen of *O. gazella* described above.

Genus *ÆGORYX*, nov.

Differs from *Oryx* in possessing a preorbital gland, a more reduced rhinarium, and curved horns.

Type, *Ægoryx algazel*, Oken.

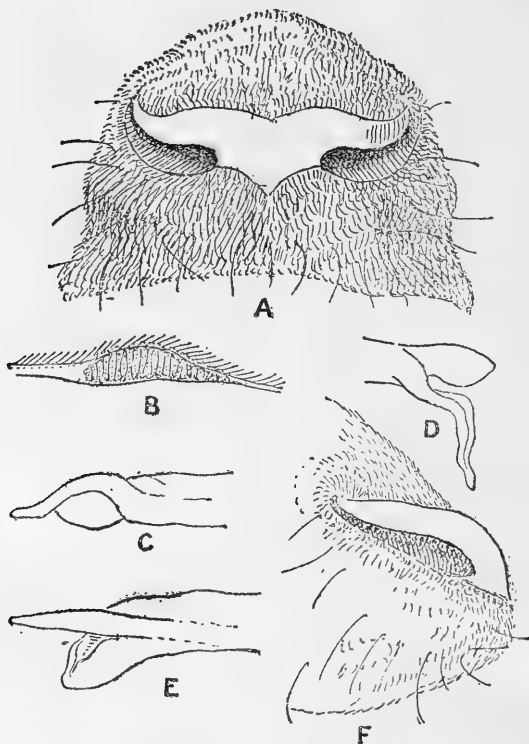
Ægoryx algazel, Oken (p. 909).

In 1910 my notes on this species were restricted to the statement that an example living in the Gardens showed the presence of preorbital glands by patches of secretion on the face about one inch in front of the eye, thus disproving the assertions of Owen and Ogilby that the preorbital gland is absent.

* In the figures illustrating the muzzle of the antelopes described in this paper, no attempt has been made to indicate by shading the transverse and vertical convexity of the rhinaria, which thus appear to be too flat.

In an example of the typical race of this species from Northern Nigeria, the gland (fig. 4, B) consists of a thickened area of skin concealed and overgrown by hair basally adherent with secretion. The gland is about 30 mm. long and 6 mm. thick and slightly elevated, resembling the

Fig. 4.



- A. Muzzle and rhinarium of *Aegoryx algazel* from the front. $\times \frac{1}{3}$.
 B. Preorbital gland of the same in longitudinal section.
 C. Extremity of the penis of the same from the left side.
 D. The same from the right side with urethral process pulled down.
 E. Extremity of penis of *Hippotragus niger* with urethral process straightened.
 F. Muzzle and rhinarium of *Oryx gazella* from the side.

corresponding gland of *Hippotragus*, although shorter as compared with its thickness.

The muzzle (fig. 4, A) in its general features is like that of *Oryx gazella*, but the rhinarium is considerably more reduced. When viewed from the front it is much wider as

compared with its height, the height in the middle line being slightly less than that of the upper lip and much less than the width of the internarial septum.

As in other members of this subfamily the *inguinal glands* are absent, there are two pairs of *mammæ*, and the *pedal glands* are present and constructed as in *Oryx*.

The *penis* (fig. 4, C, D) is remarkable for the thickness and length of the tubular prolongation of the urethral canal, which projects some distance beyond the ovate termination of the glans and is nowhere adherent to it. It rises from the underside of the cylindrical portion of the penis, and, although normally closely applied to the left side of the well-defined terminal portion, is in reality separable from it. It is thick at the base and gradually attenuated apically.

The penis closely resembles that of *Addax* as described and figured by Garrod (P. Z. S. 1877, p. 10, fig. 18) ; but Gerhard's figure of the penis in *Addax* has a much shorter urethral prolongation, not overlapping the tip of the glans (Verh. Deutsch. Zool. Ges. xvi. p. 153, 1906).

Genus HIPPOTRAGUS, Sund.

Hippotragus niger, Ham. (p. 909).

Specimens examined since 1910 confirm in every particular the facts stated in that year as to the structure and incidence of the cutaneous glands. The new facts here recorded relate to the rhinarium and the penis.

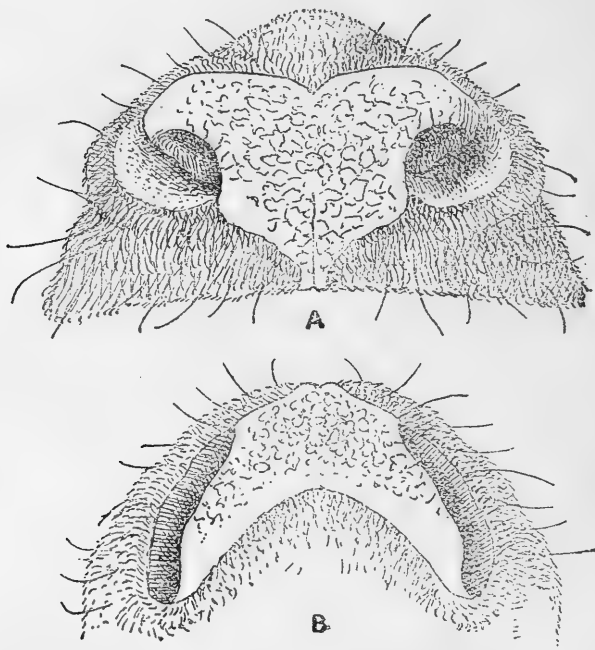
The muzzle (fig. 5, A, B) is less depressed than that of *Oryx*, and the sculptured rhinarium is relatively larger and more normal, with a better defined naked tract below the nostrils, a well-developed philtrum mesially grooved, broad at the base, and narrowed below where it reaches the inferior edge of the upper lip ; the nostrils are more expanded with the upper lid more swollen, so that from the anterior aspect the upper edge of the rhinarium appears to be biconvex with an angular median depression and from the dorsal aspect the anterior edge is seen to be transversely truncated. The hairs of the upper side of the nose extend some distance between the nostrils, although not so far as in *Oryx*, so that the posterior border of the rhinarium is strongly concave.

The *penis* (fig. 4, E) resembles that of *Ægoryx*, described above, in the thickness, length, and freedom of the tubular prolongation of the urethral canal, but the termination of the glans is less markedly bulbous.

The *Oryginæ*, apart from *Addax* which requires examination, are a remarkably uniform group with respect to the

structure of the penis, the presence of four mammæ, the absence of inguinal glands, and the presence on all four feet of flask-shaped pedal glands with narrow exit passage and small circular orifice just behind the summit of the interungual web.

Fig. 5.



A. Muzzle and rhinarium of *Hippotragus niger* from the front. $\times \frac{1}{3}$.
 B. The same from above.

Setting *Addax* aside, the genera discussed in this paper may be distinguished as follows:—

- | | |
|--|---------------------|
| a. Rhinarium sculptured, with distinct philtrum reaching lower edge of upper lip; upper rim of dilated nostrils swollen; horns rising erect from head .. | <i>Hippotragus.</i> |
| a'. Rhinarium smooth, without philtrum, upper lip entire; upper rim of narrow nostrils not swollen; horns inclined backwards in the plane of the forehead. | |
| b. Preorbital gland present as a thickened pad of skin like that of <i>Hippotragus</i> ; rhinarium shallow; horns curved | <i>Ægoryx.</i> |
| b'. Preorbital gland absent; rhinarium deeper; horns straight | <i>Oryx.</i> |

Addax differs from the three above enumerated genera in having broad rounded hoofs, the interdigital web exceedingly thick above, the pedal glands represented by a short narrow cylindrical tube, corresponding to the duct of the gland in *Hippotragus* and *Oryx*, and the horns spirally twisted (Proc. Zool. Soc. 1910, pp. 910-911).

XXV. — *Descriptions from the Joicey Collection of new Species of Syntomidæ, Nymphalidæ, and Hesperidæ, and Two Genera of Syntomidæ.* By W. J. KAYE, F.E.S.

ALL the new species herein described will be figured after the war. The striking new *Chlorippe* from Haiti is so far unique. It is a ♀ and could scarcely be a ♀ ab. of *cherubina*, the species it doubtless comes closest to. In Cuba *Chlorippe laure* occurs, but the present insect is certainly not a ♀ of that species, although it is highly possible that *laure* occurs in Haiti.

The new race of *Anæa xenocrates* from French Guiana, although different in the ♂ from the typical species, has a ♀ (only a single specimen) that is exceedingly like the ♀ at Ting of the type-form from Bolivia. The female of this species appears to be exceedingly rare, and it was rather surprising to get a single pair from quite a new locality.

Syntomidæ.

TIGRIDANIA, gen. nov.

Proboscis well developed. Palpi long, upturned, reaching well above head, and separated widely at base, but meeting above the head. Antennæ bipectinate in both sexes, longer in ♂. Legs fairly long. Hind tibiæ with two pairs of spurs of nearly equal length and strong spines on the tarsal joints. *Fore wing with vein 3 a long way before end of cell and distance between veins 2, 3 less than that between 3 and 4.* Veins 4, 5 from angle of cell; a fold between 5, 6, extending across cell; 11 from cell; 7, 8, 9, 10 stalked. Costa greatly bulged at base. Hind wing with the lower discocellular very short and oblique; veins 2 and 4 on a long stalk, 3 absent, 5 present, 6 and 7 from upper angle.

Type, *quadricincta*, Kaye.

The genus comes nearest to *Sarosa*, from which it differs markedly in the position of veins 2 and 3 of the fore wing.

Tigridania quadricincta, sp. n.

Fore wing smoky transparent, with the costa broadly black from before discocellular to apex, which is very broadly black. Discoidal spot black; outer margin with an extension inwards along vein 2, and inner margin with an extension along vein 1 *b* heavy black. Hind wing bluish transparent with hardly any smoky appearance; outer and inner margins heavily black and costa clothed with pale yellowish hair. Abdomen with four yellowish segmental rings. The last four segments black. Fore coxæ whitish beneath. Frons white; gulæ pale yellowish; tegulæ with two pale yellowish spots. Mesothorax with a long central pale spot and patagia with a pale area at base and a pale stripe beyond middle. Metathorax with two pale spots.

Expanse 66 mm.

Hab. Upper Amazons, Rio Ucayali.

Type in Coll. Joicey.

Autochloris crinopodu, sp. n.

Head black with blue scaling at vertex; tegulæ black with blue patches; shoulders with white spots. Thorax and patagia black. Abdomen black with indistinct sublateral blue patches; last four segments crimson. Hind tibiæ with dense orange tufts of hair. Fore wing hyaline with heavy black margins; a heavy black discoidal blotch and a similar blotch between cell and inner margin. Hind wing hyaline, with the outer margin broadly black and a small black discoidal mark. Abdomen below with only the last two segments crimson. Fore coxæ with exterior patches of white scales.

Expanse 41 mm.

Hab. Cayenne.

1 ♂.

Ab. lutea, nov.

Abdomen with the last three segments yellow, the fourth only yellow laterally.

Hab. Ecuador, Sarayacu (*C. Buckley*).

Saurita pebasa, sp. n.

Head black, tegulæ black; patagia with large red patches; shoulders with red patches. Abdomen black. Fore wing smoky black, darker about the discocellulars and with a pale

transverse area across the disc. Hind wing smoky black, darker at apical area and inner margin.

Expanse 22 mm.

Hab. Peru, Pebas Loreto, 1913.

Chrostosoma guianensis, sp. n.

Head black with some blue scaling behind the eyes. Thorax black; patagia with red spots and a red spot on the shoulder. Metathorax with a blue spot. Abdomen black, legs and palpi black. Fore wing hyaline, smoky, with dark scaling at base, along inner margin, and at apex. Hind wing smoky hyaline, with apex and inner margin narrowly darker.

Expanse 28 mm.

Hab. British Guiana.

Chrostosoma halli, sp. n.

Head and thorax black. Shoulders with red patches. First abdominal segment with a pair of subdorsal red spots. Abdomen black with some metallic-green scaling, especially on last three segments. Abdomen beneath white on first three segments and with orange sublateral patches on fifth and sixth segments. Fore wing yellowish hyaline, with the costa narrowly black beyond the cell and with the apex black. Outer margin very narrowly black. Hind wing yellow hyaline; outer margins narrowly black, becoming broader at anal angle.

Expanse 33 mm.

Hab. Guatemala, Barrios, 22. xii. 12 (*A. Hall*).

Pheia serpens, sp. n.

Head black; frons metallic green. Tegulæ orange with a few blue-green scales. Patagia orange. Coxæ vermilion-red. Abdomen above orange with a broad expanding median stripe of blackish brown. Abdomen beneath with a large white valve covering the basal segments. Last five segments black-brown. Fore wing with costa as far as discoidal cell orange, and inner margin for half the distance orange. Wings hyaline. Discoidal spot black, rather rectangular. Outer margin broadly black; apex broad, black. Hind wing transparent, the margins black. Antennæ with the tips white.

Expanse 26 mm.

Hab. Lower Amazon, Serpa, Jan.-Mar. 1914 (*A. Hall*).

Pheia nanata, sp. n.

Head black with vertex of head, *tegulæ*, *frons*, and shoulders with metallic-green spots. Abdomen with first segment with sublateral red spots and a series of faint dorsal green spots. Fore coxæ brilliant vermilion-red. A large white valve covering basal segments beneath. Fore wing transparent with costa, discoidal spot and outer margin black, the last broad at apex and expanding inwards at vein 2. Hind wing with the costa and cell filled up with dark scaling. Apex rather broadly black.

Expanse 26 mm.

Hab. Peru, Rio Pacaya, Lower Ucayali, Aug.-Sept., 1912.

Related to *Pheia hæmapera*, Schs.

Rhyncopyga discalba, sp. n.

Frons black, vertex of head black. Collar orange, *tegulæ* orange. Thorax and abdomen black. First two joints of palpi orange. Coxæ and valve covering basal segments white. Underside of last five abdominal segments orange. Fore wing with the basal half transparent. Discal half of wing dull black, containing a large white discoidal spot. Median vein heavily scaled with blackish. Hind wing transparent with a broad black apex.

Expanse 19 mm.

Hab. Panama, Bugaba.

Related to *R. flavicollis*, Druce.

Cosmosoma ochreipennis, sp. n.

Palpi orange; frons yellowish. Blue spots behind antennæ. *Tegulæ* black with metallic-blue spots. Patagia black with a central orange streak. Hind tarsus black above, orange beneath. Thorax black. Abdomen black, segmented with orange and with subdorsal metallic-blue spots, the last five segments with a subsidiary second row of blue spots. Fore wing transparent yellowish, the costa yellow, apex broadly black, and outer margin narrowly black, wider at tornus. Hind wing transparent yellowish with a narrow black outer margin.

Expanse 32 mm.

Hab. Peru, Contamana, Rio Ucayali, xi.-xii. 1912.

Gymnelia semicincta, sp. n.

Frons black, between antennæ bluish black. *Tegulæ* with brilliant blue patches. Patagia black. Thorax black.

Abdomen with first segment above orange, becoming paler at sides. A broad black dorsal fascia running down the remaining segments, edged on the sides with orange segmental bands and interspaces of bluish scales, especially on the sixth and seventh segments. Fore wing with a small bunch of white scales at base. Costa yellowish, becoming orange beyond the cell. Inner margin orange on basal half. Outer margin black, the apex very broad, the remainder very narrow. Wing-membrane yellow. Hind wing slightly less yellow than fore wing. Inner margin rather broadly black, outer margin narrow.

Expanse 25 mm.

Hab. Colombia, Valparaiso.

Mesothen demicostata, sp. n.

Palpi black; vertex of head metallic blue-green; legs orange. Tegulæ and patagia edged orange. Metathorax and first five segments of abdomen with orange segmental bands. Fore wing yellowish transparent. Costa on the central area bright orange; basally and on apical third black. Apex rather narrowly black and outer margin very narrowly black. Inner margin narrowly orange, except at base, which is black. Hind wing yellowish transparent, with outer margin narrowly black.

Expanse 28 mm.

Hab. W. Colombia (San Antonio), 5800 ft., Nov. 1907 (*M. G. Palmer*).

Rhyncopyga semirufa subochrea, subsp. n.

Fore wing lighter, more ochreous than in *semirufa*. No dark discoidal mark and with the dark marginal band greatly narrowed at tornus. Between discocellulars and marginal band a broad ochreous shade. Hind wing paler than *semirufa* and with a slightly narrower marginal band. Fore wing below with distinct ochreous postdiscal band.

Expanse 26 mm.

Hab. N. Peru, River Tabaconas, 6000 ft. (*A. E. & F. Pratt*), 1912.

PSEUDODIPTERA, gen. nov.

Proboscis absent; palpi slightly downcurved; antennæ bipectinate, with long branches. Thorax and second segment of abdomen clothed with hair. Fore wing long; vein 3 long before end of cell; 4, 5 on a short stalk; 6 from middle of discocellulars, curving down greatly towards vein 5; 7, 8, 9, 10, and 11 stalked. Hind wing small, greatly cut away

at apex; veins 3 and 5 widely separated, 4 absent, 6 absent. A short veinlet in the cell.

Type, *musiforme*.

Pseudodiptera comes nearest to *Apisa*, from which it differs in having veins 3 and 5 of hind wing widely separated at origin and in having vein 6 of fore wing from middle of discocellulars.

Pseudodiptera musiforme, sp. n.

Palpi black; frons with large white spot. Head black with metallic-blue spot between antennæ. Tegulæ with white patches. Patagia black with white spot at base of wing. Below, fore coxæ white and white patches at base of tibiæ. A broad orange stripe on underside of abdomen. Abdomen above black with dark green metallic segmental bands. Fore wing transparent, the margins narrowly black. Discoidal spot narrowly black, connected with outer margin by a short black streak along vein 5. Inner margin with a black extension inwards midway. Hind wing transparent, with the costa and cell filled up with blackish.

Expanse 24 mm.

1 ♂.

Hab. Congo, Oubangui-chari, Tschad.

Type in Coll. Joicey.

Family *Hesperiidæ*.

Subfamily *PAMPHILINÆ*.

Pseudosarbia campicola, sp. n.

Head, thorax, and abdomen dull brownish black. Fore wing above dull brownish black, with a broad, macular, creamy-whitish, transparent, median band, commencing on costa as a small whitish dot succeeded by a rather square spot within the cell; a much larger and more transparent spot between veins 2, 3, and a creamish-white, more opaque spot lying beneath, but not reaching the inner margin by about 1–2 millimetres. Cilia same as the ground-colour, except for a large white area at tornus. Just beyond cell is a broad regular white band from costa to vein 4, with the veins showing through brownish. Between veins 3, 4 near cell is a small white comma-like mark. Fore wing below as above, except that instead of a small white dot on costa at commencement of band there is a pale yellow streak.

Hind wing above dull brownish black with a broad white band from vein 8 to vein 2 divided up into sections by the dark brown veins. Cilia at apex brown, becoming white thence to tornus, where it is considerably longer. Hind wing

below as above, except for a straight yellow streak within the cell which runs beyond the discocellulars along the fold in place of vein 5.

Abdomen beneath with paired white spots on sternites 4, 5, 6, 7, and 8.

♀. Like the male, except that all the white markings are broader.

Expanse, ♂ 52 mm., ♀ 58 mm.

Hab. S. Brazil, Parana, Ponta Grossa, 1 ♂, 30. 3. 1910 (W. J. Kaye). Uruguay (E. Trimen).

♂ type in Coll. Kaye. ♀ type in Coll. Joicey.

The habitat of this striking "skipper" is open grassy campo in S. Brazil at 3000 ft. elevation. Hardly another butterfly was to be seen where the ♂ was caught, although a close search was made at the time for further specimens of what I recognized at the time as a rarity.

On the label of the ♀ specimen labelled Uruguay it is stated "Mr. W. C. Hewitson had this Hesperid from me [Rowland Trimen] to describe and figure together with the specimen of *Papilio hellanichus* (also from Uruguay); but although he attached to it the label '*Apheka*' I have not found that he published any description or figure of it.—R. Trimen."

The type of *Papilio hellanichus*, once in the Trimen collection, was acquired with the whole collection by Mr. Joicey.

Family Nymphalidæ.

Chlorippe speciosissima, sp. n.

♀. Fore wing ochre-yellow with two black transverse marks, the one within the cell flat V-shaped, the other lying along discocellulars. A pale transverse band across disc, straight to vein 3, then set back and broken; a conspicuous blackish spot surrounded with reddish ochreous near tornus between veins 2 and 3. A dark shade in subapical area containing two pale round spots. Subterminal black line regular preceded by a crenulated black band which merges in the dark subapical area. Hind wing ochre-yellow with a small round black spot within the cell, lying close to origin of vein 7. Costal area brownish black with a square whitish patch in middle, which represents the end of a transverse band which is almost obliterated. A large black spot surrounded with reddish ochreous between veins 2, 3. Subterminal line black, regular to vein 2, where it is strongly toothed and edged externally with grey. A heavy black inner crenulated band also strongly toothed at vein 2. Outer margin crenulated. Underside of hind wing pinkish silvery

with the upperside markings showing through, and with a well-defined central whitish band becoming more or less merged with the ground-colour at anal angle.

Expanse 82 mm.

Hab. Haiti, no precise locality.

Type in Coll. Joicey.

Anæa xenocrates punctimarginale, subsp. n.

♂. Differs from *xenocrates xenocrates* from Bolivia in the fore wing by having no blue scaling at tornus and in the blue subapical spots being widely separated and showing no tendency to unite inwards. Hind wing with a series of rather small triangular blue marginal spots, not a band as in the Bolivian form.

♀. Shows much less difference from type-form. The margin of hind wing is yellow banded as in the ♀ from Bolivia. There is an extra yellow spot between veins 3, 4, smaller than that between veins 2, 3.

Expanse 82 mm.

Hab. French Guiana, St. Jean de Maroni.

1 ♂, 1 ♀.

Type in Coll. Joicey.

The occurrence in French Guiana of a species only known hitherto from Bolivia and the Upper Amazons (Pebas) is strange, and at first suggests specific difference and not sub-specific. But the species is rare, the ♀ exceedingly so, and its range may lie across the interior of Brazil where it could easily remain undetected. The species has been chiefly known from Eastern Bolivia, but the few specimens known from Pebas belong to the same form with a blue marginal hind-wing band in the ♂.

XXVI.—*Observations on the Genus Lysorophus, Cope.*

By ROBERT BROOM. *With a Note*, by Prof. W. J. SOLLAS.

So much has already been written about this little vertebrate by Broili, Case, v. Huene, Moodie, Finney, and Williston that it might seem doubtful wisdom to add another paper to the already extensive literature, and more especially as my observations are on specimens already carefully examined by Case and v. Huene; but when one considers that *Lysorophus* is the most remarkable land vertebrate that has been discovered for many years, and that opinions not only differ as to its affinities but also as to the interpretation of a number of the cranial elements, a further review of even the present evidences seems justifiable.

There is no lack of material. The Chicago Museum has 200 nodules, each containing much of the skeleton of a specimen: the American Museum, New York, also has many nodules, and in the American Museum nine skulls have been chiselled out, one or two in very good condition. In Tübingen there are 24 skulls, and at Munich a considerable number more.

As the extensive literature has been reviewed by Williston and others, it will be unnecessary to enter into this in detail. To Broili we owe the first really good figures of the skull, but there are one or two points in his interpretation that I, in common with all later writers, do not accept, and from his conclusion as to the affinities of the genus I also differ.

Case gives a brief description of the more conspicuous elements of the skull, and reproduces Broili's and Williston's figures. As these two figures differ in a number of points, one could have wished that Case had given an original figure of his own interpretation, and his description, while pointing out the different views, does little to clear up the matter.

Williston gives us clear definite views as to the structure of the skull and skeleton, and equally clear opinions as to the affinities of the genus.

Von Huene, the latest worker on the genus, has just issued a paper on *Lysorophus* in the 'Anatomischer Anzeiger,' and another paper is in the press describing the specimens in the American Museum. Though these two papers are appearing in the same year, I believe that the one in the 'Anatomischer Anzeiger' to be the later. On one or two points the opinions expressed differ in the two, and it is therefore well to know which is the latest. Von Huene has figured a number of the better skulls in the American Museum, and gives us clear opinions not only on the structure, but also on the affinities of the genus.

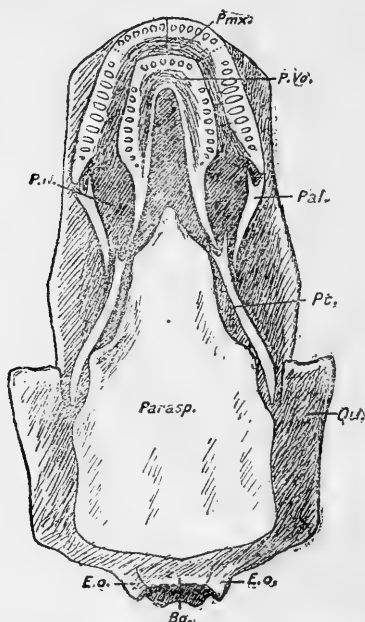
The skulls in the American Museum, though comparatively few in number, are mostly well preserved, and there is scarcely a point in the structure that cannot be made out in one or other.

The best figures published of the top of the skull are those of Broili and Williston, and they differ, apart from interpretations, only in the relative width of the nasal region. While neither is altogether correct, a composite of the two would give the truth. The difference arises from the peculiar state of affairs in front of the prefrontal. Broili correctly recognises a round opening here which he regards as the nostril. It is also shown in Williston's specimen. The most natural conclusion would seem to be that this is

the nostril, but two of the American Museum specimens seem to indicate that the opening extends somewhat inwards and forwards, and one would like to see a specimen showing the perfect snout to feel quite sure that this opening is the nasal opening and not perhaps also an opening for some sensory organ.

There is a small premaxilla—possibly toothed. It is figured by v. Huene. The maxilla is slender and carries about ten teeth. Its posterior end articulates, I believe, with the palatine. It forms the floor of the nasal opening

Fig. 1.



Restoration of the underside of skull of *Lysorophus tricarinatus*,
Cope, $\times 5$.

and perhaps its posterior border. The doubt lies in the fact that in the specimens it is impossible to be quite sure whether the bridge of bone which connects the prefrontal with the maxilla is a part of the prefrontal or a part of the maxilla or a small independent bone.

One specimen shows most of the palate. The bones are a little crushed and fractured, and the interpretation I give is made with some hesitation (fig. 1). Von Huene figures the specimen, but his interpretation differs somewhat from mine,

which agrees pretty closely with Broili's. I consider v. Huene in error in regarding that there are "two large, elongate internal nares, separated by a narrow bridge." The large supposed left choana of v. Huene I regard as the median vacuity between the prevomers, and the narrow bridge as the right prevomer. The figure I give will show how I interpret the palatal structures. The prevomers form a horseshoe-like arrangement with posterior processes passing back to the parasphenoid and apparently articulating with the pterygoids. The teeth on the prevomers are well shown in this specimen. In front there are about 6 and about 8 on each side. The palatines are delicate bones extending from the maxillæ to the pterygoids. Between the palatines and prevomers are, I believe, the internal nares. The pterygoids extend back as rather delicate bones to meet the quadrates. The parasphenoid is a very large bone, which forms nearly the whole of the base of the posterior two-thirds of the skull. The supposed suture figured by v. Huene between the parasphenoid and the basisphenoid is, I think, a fracture merely.

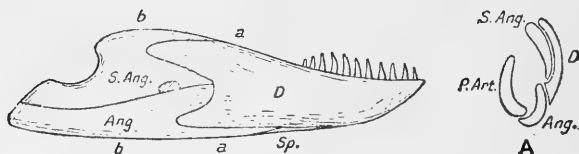
The figure I give of a transverse section of the skull (fig. 3) shows the relations of the pterygoid to the parasphenoid, and also the elements of the back of the mandible.

In Broili's figure A of the side view of the skull, there are seen in the orbital region some deep-seated elements. These are also shown in two of the American Museum specimens. In what might be regarded as the sphenethmoid region there appear to be three elements with a deep posterior notch. In one of the New York specimens an almost exactly similar appearance is shown, and further back an elongated element very like an eipterygoid in appearance. Though these elements have been seen by Broili, neither he nor anyone else appears to have expressed any opinion as to what they were. After considering many possibilities I have come to the conclusion that they are ossifications or calcifications in the cartilaginous brain-case. The anterior elements look as if separated by sutures, but, whereas all true sutures in the skull and even cracks are filled with the red clayey matrix, these divisions are formed of clear calcite which probably indicates that they were originally formed by hyaline cartilage. Further, in a second specimen the ossification appears to be entire. The posterior narrow vertical element is also, in my opinion, an ossification of the cranial cartilage. It certainly has much superficial resemblance to a reptilian eipterygoid. It articulates with the parietal above and passes down to at least near to the pterygoid. It thus answers in position to the eipterygoid.

But though in front it has a smooth edge the posterior edge is irregular, as if indicating an ossification in cartilage. The anterior ossification or ossifications probably correspond to the sphenethmoid of *Siredon* or the frog, and the posterior to the ossification seen in Dinosaurs, Crocodiles, and birds, and usually, but I think wrongly, called alisphenoid.

The quadrate is large and its upper half is largely hidden by the squamosal. There need not, I think, be the slightest

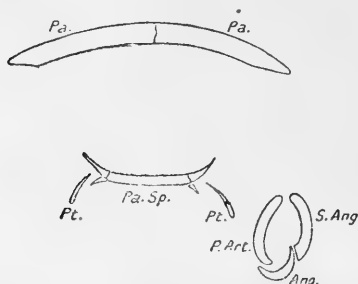
Fig. 2.



Lower jaw of *Lysorophus tricarinatus*, Cope, $\times 5$. **A** represents a section at *a a*.

Ang., angular; *D*, dentary; *P. Art.*, prearticular; *S. Ang.*, surangular.

Fig. 3.



Section across skull and jaw of *Lysorophus tricarinatus*, Cope, $\times 5$. The section of the lower jaw is near the point indicated by *b b* in the figure of the jaw. The outer corners of the parasphenoid are separated by cracks or sutures. They are believed to be parts of the parasphenoid.

Ang., angular; *Pa.*, parietal; *Pa. Sp.*, parasphenoid; *P. Art.*, prearticular; *Pt.*, pterygoid; *S. Ang.*, surangular.

doubt about this bone being the squamosal—the view also held by Williston and v. Huene.

The occiput has recently been figured by v. Huene from one of the American Museum specimens and also from one of the Tübingen specimens. His drawing of the American Museum specimen is not in my opinion quite accurate, the American specimen agreeing closely with his figure of the Tübingen specimen. The main difference between the two

is that in the drawing of the American specimen the exoccipital is represented as very small. This is, I think, wrong, the exoccipital being large, as represented in the drawing of the Tübingen specimen. The drawing v. Huene gives of the occipital condyle is thoroughly satisfactory, showing that the articulation is as much basi- as exoccipital. Von Huene's identifications of the fenestra ovalis and foramen for the vagus are probably correct.

The large bone situated by the sides of the supraoccipital has been very variously identified. By Broili and Case they have been called squamosals, by Williston epiotics, and by v. Huene supratemporals. That they cannot be squamosals requires no argument, the undoubted squamosals lying in front. Nor can they, I think, be regarded as supratemporals. From their being quite behind the parietals, and at the sides of the supraoccipital and far behind the jaw, it is very doubtful if they in any way roof the temporal region. They may be epiotics, but we do not know any forms in which epiotics take up this position. They further appear to overlap the supraoccipital, and to be thus membrane bones. It seems to me that they, however, answer all the requirements of the tabulares. They lie on the outer part of the paroccipitals, are behind the parietals, and articulate with both the parietals and squamosals, and to form the upper lateral parts of the occiput.

The lower jaw has never been fully described. Von Huene figures one of the specimens in the American Museum, but with one or two of his interpretations I do not agree. He has also examined some jaws in the Tübingen Museum, but they have apparently not yielded any fresh light. The American Museum specimen, no. 4761, shows something of the jaw, but not nearly so much as two other specimens not numbered. Between these three specimens practically all details can be made out (fig. 2).

The dentary forms about two-thirds of the jaw. It comes to a sharp point in front and forms with its neighbour a short feeble symphysis. It articulates on the outer side behind with the surangular and angular. The splenial is a small bone lying on the inside of the lower part of the dentary just behind the symphysis. It forms the lower margin of the jaw in this region. The angular forms nearly the whole of the lower border of the jaw, passing in front between the dentary and the splenial. From two of the American Museum specimens I incline to differ from v. Huene, and believe that the splenial does not form part

of the symphysis. The surangular forms the upper half of the back of the jaw as indicated in the figure. Von Huene is, I think, in error in regarding the large opening in the side of the jaw in specimen 4716 as natural. Only a small part is, I believe, a natural opening, the rest due to faulty preparation. In other specimens the lateral opening is quite small, as indicated in the figure. I find no evidence of a coronoid element. Inside the jaw is a large prearticular. The articular is evidently quite small, and possibly cartilaginous.

Though the structure of the skull of *Lysorophus* may now be said to be pretty well known, there is still some little doubt as to the affinities. *Lysorophus* agrees closely with no known animal, recent or extinct. With Williston I agree in holding that *Lysorophus* is not a reptile. All known reptiles are either Cotylosaurs or are manifestly derived from Cotylosaurian ancestors, but *Lysorophus* is neither a Cotylosaur nor can it have been derived from a Cotylosaur. The supposed reptilian resemblances are entirely fallacious. Von Huene in his recent paper, though correctly figuring and describing the occipital condyle, says: "this condyle is intermediate between the true reptilian condyle and the true amphibian condyle The structure of the condyle shows a great resemblance to that of the Theromorphs and of Turtles." In Theromorphs and Turtles the condyle is a tripartite condyle, of which the upper two-thirds are formed by the exoccipitals and the lower third by the basioccipital. In most Chelonians and Theromorphs the exoccipitals come close together, and the basioccipital is squeezed out from the foramen magnum. In all generalised forms the condyle is a projecting rounded structure which articulates with the arches of the atlas and with the intercentrum. In *Lysorophus* the whole articulation is with the centrum of the atlas, which fits close into the broad hollowed out surface formed by the basi- and exoccipitals. The presence of a large articular surface on the basioccipital seems at first sight to be a non-Amphibian character, but, as Watson has recently pointed out, this is the primitive Amphibian condition. The early Stegocephalians of the Lower Carboniferous, such as *Pteroplax*, have the basioccipital forming practically the whole of the articulation, the exoccipitals only very gradually in later forms taking the place of the basioccipital. So that, so far from the occipital condyle of *Lysorophus* indicating any reptilian affinities, it is really in a more primitive condition than is found in any other Permian or later Amphibian.

Doubtless Williston is right in regarding *Lysorophus* as a mud-borrowing animal, and many of its specialisations are due to this habit, such as the greatly elongated snake-like body with very numerous vertebræ, great reduction of the limbs, relatively small size of skull, loss of the arches, and advanced position of the quadrate. And the somewhat similar characters, acquired by convergence in other groups which have similar habits, have given rise to some striking superficial resemblances to *Lysorophus* in the Gymnophiona, the Amphibænans, and the Typhlopidae.

But, apart from all modifications in *Lysorophus* due to a burrowing habit, the skull is undoubtedly fundamentally an Amphibian skull, and the only known Amphibia, recent or extinct, with which it seems at all allied are the Urodela, and, more remotely, the Anura and the Gymnophiona.

Note by Prof. W. J. SOLLAS.

Some years ago Dr. Broom obtained, through the kindness of Dr. Matthew, two specimens of *Lysorophus*, and these he presented to me for investigation by serial sections; at the same time he made a most generous addition to this gift by placing in my hands, to dispose of as I thought fit, a paper embodying the important conclusions to which he had been led from his study of the specimens in American museums.

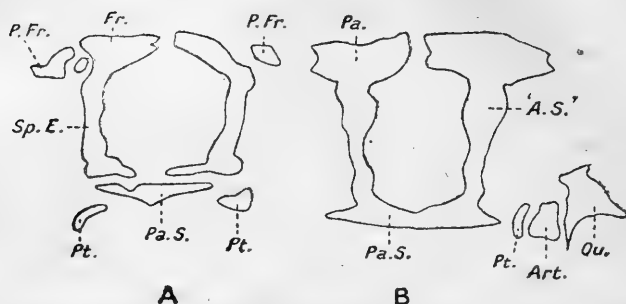
My own study is now completed, and I hope soon to give a full and exact account of the structure of the skull in all its details. This will confirm all the more important conclusions of Dr. Broom, and in justice to him I can no longer withhold from publication the paper which he entrusted to me in 1914.

One or two minor emendations ought, perhaps, to be made. Thus, the vacuity between the vomers, as it is represented in fig. 1, does not really exist; these bones are without thickened margins and meet in the middle line; and, again, the articulare of the lower jaw is a comparatively large and important bone.

On the other hand, there can be no doubt that the cranial walls include, as Dr. Broom suggests, a large "sphenethmoid" and "alisphenoids." These are shown in section in the accompanying figures (figs. 4 & 5).

The whole anatomy of the skull recalls in a striking manner that of *Siren* or *Menopomus*, and to my mind *Lysorophus* is without doubt an ancestral Urodele. It presents some remarkably interesting primitive characters.

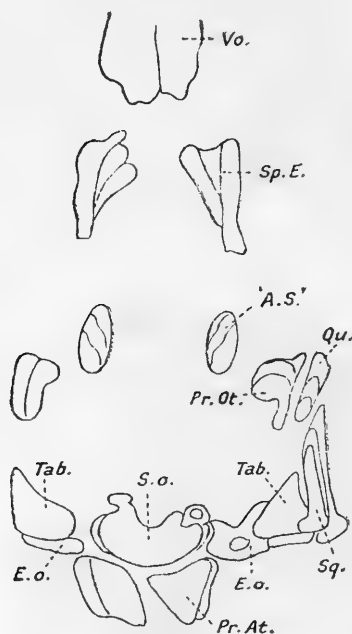
Fig. 4.



Transverse sections of skull of *Lysorophus*, to show the sphenethmoid and "alisphenoid" bones.

- A. Sphenethmoid: *Fr.*, frontal; *Pa.S.*, parasphenoid; *P.Fr.*, prefrontal; *Pt.*, pterygoid; *Sp.E.*, sphenethmoid. B. "Alisphenoid" ('*A.S.*'): *Art.*, articular of lower jaw; *Pa.*, parietal; *Qu.*, quadrate.

Fig. 5.



Three horizontal sections superposed.

- Vo.*, vomers; *Pr.Ot.*, pro-otic; *Sq.*, squamosal; *S.o.*, supra-occipital; *E.o.*, exoccipital; *Tab.*, tabulare; *Pr.At.*, pro-atlas.

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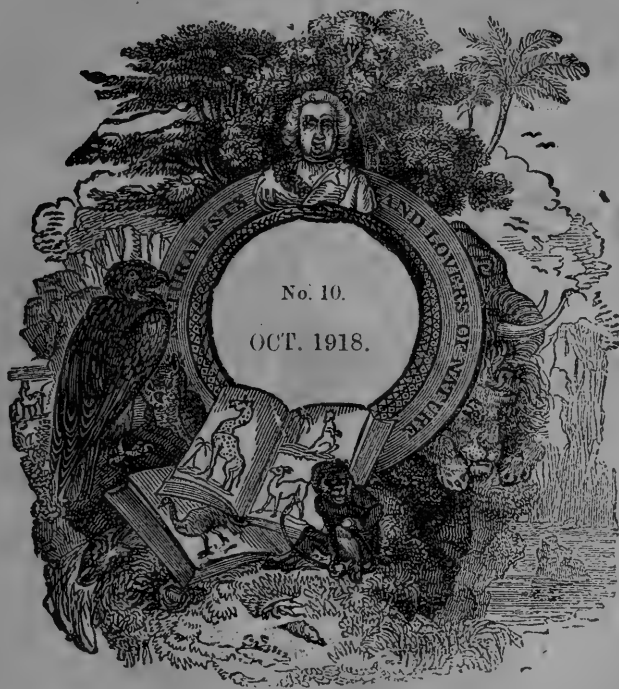
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XXVII.—*On the Races and Variation of the Edible Frog,*
Rana esculenta, L. By G. A. BOULENGER, F.R.S.

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AFTER all I have written in the past on this common Batrachian, it may seem surprising that I should think it worth while to revert to the subject. The reason is that it is far from exhausted; that I have never ceased accumulating material*, in the course of recently reviewing which I perceived characters hitherto overlooked; that it was desirable to test the value of certain differences appealed to within the last few years by advocates of the extreme multiplication of species; and that it is always useful to deal with individual variations, when large series of specimens are available, in order, by showing the instability of certain characters, to ensure a more correct appreciation of their importance when treating of allied species represented by less extensive material. Not that I think inconstancy in one case invariably follows in another, but such examples teach caution, and should be a warning to the inexperienced.

Considering modern tendencies in zoography, it cannot be too often repeated that the method of describing so-called species and subspecies from single specimens† or from at

* About 800 specimens are now before me, selected from at least twice as many that have passed through my hands.

† "On aura beau multiplier les espèces, on arrivera toujours à ce résultat que la description exacte d'un sujet pris au hasard, parmi soixante récoltés sur des points divers d'un même rivage, ne pourra convenir à aucun des cinquante neuf autres." Duval-Jouve, *Mém. Ac. Montpellier*. vii. 1871, p. 511.

most a very few, when large series can be examined, or without reference to the data available through the labours of other investigators, is unfair to those who make use of works written on such lines. Systematics, if scientific, must take into full consideration the exceptional, aberrant, or annectant specimens, so often passed over without a word, though of so great an importance from the taxonomic and evolutionary points of view. It does not matter if thereby our definitions are obscured, the object to be attained is to depict the true state of things in Nature.

To the four forms which I have previously * distinguished, as forma *typica*, var. *ridibunda*, Pall., var. *lessonæ*, Camer., var. *chinensis*, Osb., I have recently added a fifth, var. *saharica* †, founded on specimens obtained by Dr. E. Hartert in the far interior of the Algerian Sahara (El Golea, Tedikel oases), a small race nearly related to the var. *ridibunda* of the northern parts of Algeria but differing in the shorter tibiae, constantly less than half the length of head and body and not overlapping when the limbs are folded at right angles to the body; the membrane between the toes is very deeply notched, so much so that many specimens may be described as having the foot only three-fourths webbed.

The Vomerine Teeth.

I have never seen these teeth in two series on the round or elliptic bony bases that bear them, as described and figured by Fatio ‡. They form a single series, composed of 3 to 8; in exceptional cases I find only 1 or 2 teeth (specimens of the typical form from St. Malo, Brussels, and Basle). Leydig § gives the number 3 as normal, but he cannot have examined many specimens, those on which he drew up his description being probably mostly of the var. *lessonæ*, as the figure of the foot given in his book indicates, and this number is very frequent in the variety in question, although it may rise to 5. In 8 frogs of the typical form from Basle I find only 2 to 4 teeth, whilst in 35 from other parts of Switzerland, from France, and from Germany I count 3 to 7, 4 to 6 being the usual number; I have also seen a toothless specimen from Vienna. In about 30 specimens of the var. *ridibunda* from Germany and Austria I count usually 4 to 6 teeth; 3 specimens have only 3, one has 7 on one side and

* Proc. Zool. Soc. 1891, p. 374, and Taill. Batr. Eur. p. 270 (1898).

† Nov. Zool. xx. 1913, p. 84.

‡ Vert. Suisse, iii. p. 313, pl. v. fig. 7 (1872).

§ An. Batr. Deutschl. p. 112, pl. iii. fig. 20 (1877).

8 on the other, and one (from Vienna) has but a single tooth. 3 to 5 is the usual number in the var. *chinensis*. The series of teeth are usually nearer to each other than to the choanæ, but they are sometimes equidistant in the typical form and the var. *ridibunda* and usually so in the var. *saharica*; an arrangement such as is represented on the figures in Schreiber's book* I am sure never occurs. In a female from Cadillac, Gironde (var. *ridibunda*) the teeth form long, slightly curved series, extending almost right across the space between the choanæ. The series are sometimes horizontal, sometimes more or less oblique though seldom very

Fig. 1.



Vomerine teeth in specimens from St. Malo (a, b), Cadillac (c), Basle (d), Oporto (e), and Dead Sea (f).

much so; a male from St. Malo has the series oblique on the right side, horizontal on the left. The teeth are usually exactly between the choanæ, but they may extend backwards beyond a line connecting the posterior borders of the latter, or, more exceptionally, they may be on a line with their anterior borders (specimens from Oporto and Pekin). There is no difference whatever in the disposition of the vomerine teeth that could help in the definition of the various forms of *R. esculenta*.

The Tongue.

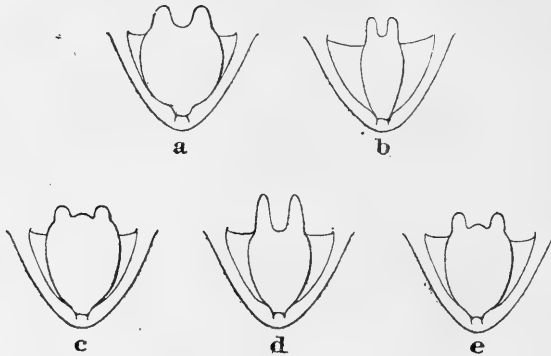
The tongue varies much in size: it may nearly cover the floor of the mouth or its width may be only about one-third that of the latter. Bedriaga† has already mentioned that the posterior processes also vary much in length according

* 'Herpetologia Europæa,' 2nd ed. (1912).—So much in this book is merely careless compilation that I need not further allude to it except to express amazement at the suggestion there made that the Spanish-Portuguese frogs named vars. *h'spanica* and *perezi* may be the same as the var. *lessoneæ*; also at reading that the males of *R. græca* and *R. iberica* are distinguished from those of allied species in having external vocal sacs.

† Lurche fauna Europa's, i. p. 36 (1891).

to individuals; this is well shown by two specimens from Florence, representing the two extremes. A more or less distinct process between the two horns is sometimes present, as in a specimen of the var. *lessonæ* from Noville, Switzerland*.

Fig. 2.



Showing the shape of the tongue in specimens from Berlin, var. *ridibunda* (a, b), Florence, f. *typica* (c, d), and Noville, var. *lessonæ* (e).

The Head.

According to Bolkay †, the three forms distinguished by him as species differ in the following points:—

R. esculenta. Head comparatively narrow, tip of snout ending in a blunt point; interorbital space equal to half, or frequently to three-quarters, the breadth of the upper eyelid.

R. ridibunda. Head broad, short, tip of snout bluntly rounded; interorbital space equal to one-third the breadth of the upper eyelid.

R. chinensis. Head narrow, long, and very pointed at the end; interorbital space equal to half the breadth of the upper eyelid.

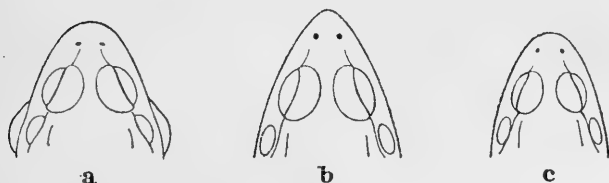
There is no constant difference in the shape of the head between the two first, and although it is a fact that *R. chinensis* usually has a narrower head and a more pointed snout,

* This process is usually distinct in the Indian *R. hexadactyla*, Less. It has been regarded as a specific character in a Central American frog (*R. trilobata*, Mocquard), which may be merely a young *R. halecina*, L.

† Proc. Washingt. Ac. Sc. xiii. 1911, p. 75.

this is by no means always so, and specimens are to be found in which the snout is much more rounded than in some *R. ridibunda*. I have selected three specimens, of which outline figures are here given, to show that the above definition of the three forms cannot be relied upon.

Fig. 3.



Upper views of heads of typical form, ♂, St. Malo (a); var. *ridibunda*, ♀, Capljina, Herzegovina (b); and var. *chinensis*, ♀, Broughton Bay, Corea (c). $\frac{2}{3}$ nat. size.

The width of the head varies between 1 and $1\frac{1}{7}$ times its length in the typical form (28 : 32 in ♀ from Havre), between 1 and $1\frac{1}{5}$ times in the var. *ridibunda* (= in some specimens from Herzegovina, France, Portugal, Algeria, Asia Minor, Persia, 36 : 43 in ♀ from Kiev), between 1 and $1\frac{1}{2}$ in the var. *chinensis*. The width of the interorbital space is $\frac{1}{3}$ to $\frac{1}{2}$ that of the upper eyelid in specimens of the typical form from St. Malo and Paris, $\frac{1}{3}$ to $\frac{2}{3}$ in others from Poitiers. In the var. *ridibunda*, taking only specimens from Germany and Austria-Hungary into consideration, it is between $\frac{1}{3}$ and $\frac{1}{2}$, but it may be exceptionally $\frac{2}{3}$ (♂ from Laaerberg near Vienna); $\frac{5}{6}$ (in a large ♀ from Damascus) is another exception. In the var. *chinensis* it varies between $\frac{2}{5}$ and $\frac{2}{3}$.

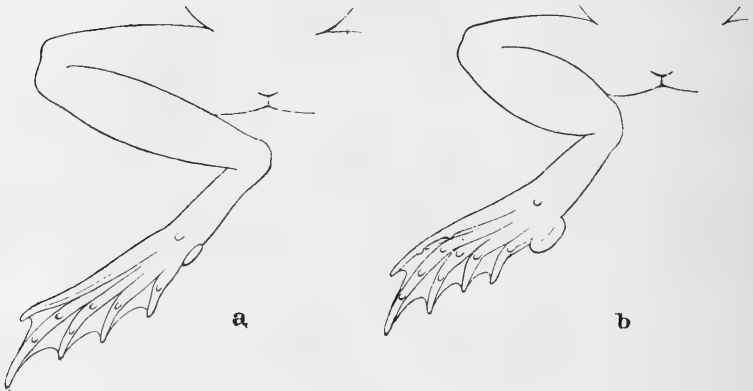
The head varies much in shape, and exceptionally may even be not unlike that of a typical *R. temporaria* (♀, var. *ridibunda*, from Crete). The canthus rostralis is always very obtuse; I have never seen a specimen in which it may be said to be "strongly marked," as stated by Bolkay in his description of *R. chinensis*.

The Hind Limb.

That there are very considerable differences in the proportions of the hind limb, I was the first to point out, and I have proposed to make use of these for defining varieties, with the necessary restrictions in the diagnoses imposed by

the many exceptions. The following figure shows how striking these differences between the extremes are :—

Fig. 4.



Hind limbs of var. *ridibunda*, ♀ from Astrakhan (a), and var. *lessoneæ*, ♀ from Stow Bedon, Norfolk (b). $\frac{2}{3}$ nat. size.

These differences reside in the length of the tibia compared to that of the head and body, to that of the thigh (causing the heels to overlap, to meet, or to fail to meet when the limb is folded at right angles to the body), and to that of the foot; also in the size and shape of the inner metatarsal tubercle, its basal length being compared to the length of the inner toe (measured from the base of the tubercle). There is another character, not made use of before, derived from the thickness of the crural or tibial part of the limb; this varies, like other characters, within certain limits, according to the actual length of the bone and the degree of plumpness of the individual, but, comparing extreme forms, it will be found that the length of the tibia is usually over 3 times its width in the var. *ridibunda* and under 3 times in the var. *lessoneæ*.

When a large material is carefully examined, it is found, however, that these differences break down for the sharp definition of the various forms; there is considerable overlap between one form and the one next to it in the series, when the measurements are tabulated, thus precluding rigid definitions :—

	1.	2.	3.	4.	5.
<i>V. ridibunda</i> ..	3-4	$1\frac{1}{2}$ - $2\frac{1}{4}$	1-1 $\frac{1}{2}$	9-14	$2\frac{1}{2}$ -4
<i>V. saharica</i>	$2\frac{3}{4}$ -3	$2\frac{1}{5}$ - $2\frac{2}{3}$	$1-1\frac{1}{5}$	9-13	$2\frac{1}{2}$ - $4\frac{1}{3}$
<i>F. typica</i>	3-4	$1\frac{3}{8}$ - $2\frac{1}{2}$	$1\frac{1}{8}$ - $1\frac{1}{3}$	7-10	$2-3$
<i>V. lessonæ</i>	$2\frac{1}{2}$ -3	$2\frac{1}{3}$ - $2\frac{2}{3}$	$1\frac{1}{6}$ - $1\frac{1}{3}$	5-8	1-2
<i>V. chinensis</i>	$2\frac{1}{2}$ - $3\frac{1}{2}$	2- $2\frac{1}{2}$	$1\frac{1}{7}$ - $1\frac{1}{3}$	5-8	$1-1\frac{3}{4}$

1. Width of tibia in length.—2. Length of tibia in length from snout to vent.—3. Length of tibia in length of foot (measured from tarso-metatarsal articulation).—4. Length of metatarsal tubercle in length of tibia.—5. Length of metatarsal tubercle in length of inner toe.

Bolkay gives the following characters for distinguishing his three species:—

R. esculenta. Heels never meet; tibio-tarsal articulation reaches space between tympanum and posterior corner of eye (♀), or, at the utmost, space between anterior corner of eye and nostril (♂); inner metatarsal tubercle large, compressed, projecting, always longer than distance between it and subarticular tubercle of first toe.

R. ridibunda. Heels always overlap; tibio-tarsal joint just reaches back corner of eye (♀), or end of snout (♂); inner metatarsal tubercle small, of flattish cylindrical form, not very projecting, always shorter than space between it and subarticular tubercle of first toe.

R. chinensis. Heels never meet; tibio-tarsal joint reaches posterior corner of eye or as far as space between anterior corner of eye and nostril; inner metatarsal tubercle very large, projecting, compressed, hard and sharp, always a good deal longer than its distance from subarticular tubercle of first toe, frequently equal to length of first toe.

The proportion of the tibia to the thigh, expressed by the meeting or otherwise of the heels, is most useful for distinguishing the races, but it varies like most other characters, and we must not shut our eyes to exceptions to the rule. To take *R. ridibunda* as an example, I now find that the overlapping of the tibiæ is not so constant as I formerly believed. Exceptions have already been noticed by Méhely* in specimens from Southern Hungary, and I find the character to break down in 4 out of 13 examples from Angora and in 3 from Damascus which have lately been submitted to me by M. H. Gadeau de Kerville; besides, I am now convinced that the var. *susana*, proposed by me for specimens from Persia †, in which the tibiæ simply meet,

* Zichy's Zool. Forschungsrr. p. 61 (1901).

† Ann. & Mag. N. H. (7) xvi. 1905, p. 552.

does not deserve to stand. These exceptions, occurring in Asia, cannot be disposed of by an appeal to hybridity, as in the case of critical specimens from Germany and Austria-Hungary, where the var. *ridibunda* occurs side by side with the typical form, which fact would render such an assumption legitimate. From what I have myself observed in the Spree lakes near Berlin, I have no doubt the two forms cross in exceptional cases, notwithstanding the asyngamy which maintains their segregation when living together, but we have no practical means of discriminating between such mongrels and truly annectant specimens.

I may mention that the tibiae feebly overlap in one specimen of the typical form from Warsaw and in another from Mestre. As regards the *R. chinensis*, I am greatly surprised at Bolkay's statement, which is contrary to the descriptions by myself and by Wolterstorff*, although supported by the description of one specimen by Stejneger†; the two first authors agree as to the heels meeting, Wolterstorff even adding that they sometimes slightly overlap; the only specimens in which I find the heels not to meet are from Kobe, Japan (two), and Pekin (6 out of 26), and they must be regarded as exceptions to the rule.

Although the hind limb is often shorter in the female than in the male, this is by no means generally the case; I can show no end of female specimens of the var. *ridibunda* from Central and Eastern Europe and Asia in which the tibiotarsal articulation reaches beyond the eye, and even one, from Alemtejo, Portugal, in which it extends to the tip of the snout—that is, farther than in most males; in a male from Corunna it reaches the eye, whilst in a female of identical size and locality it reaches between the eye and the nostril.

Bolkay's way of expressing the length of the inner metatarsal tubercle as compared to the inner toe originates from me, with certain reservations, however‡, but I have abandoned it long ago, having found many specimens of the typical form in which the tubercle is not longer than its distance from the subarticular tubercle of the first toe, whilst, on the other hand, it may be as long in specimens of the var. *ridibunda*.

It has been pointed out by Bedriaga§, Wolterstorff, and Bolkay that the usually highly developed, shovel-shaped

* Abh. Mus. Magdeb. i. 1906, p. 140.

† Herp. Japan, p. 97 (1907).

‡ Proc. Zool. Soc. 1885, p. 668.

§ Wiss. Res. Przewalski Exped., Zool. iii. i. p. 15 (1899).

inner metatarsal tubercle of the var. *chinensis* is remarkable for a certain mobility, the distal part of its base being more or less detached from the metatarsal of the inner toe with which it is connected by a web-like membrane. This character is not only inconstant in this variety, as I was able to demonstrate to the second author by sending him for identification a cut-off foot of a specimen from Broughton Bay, Corea, which he returned to me named var. *lessonæ*, but it is also found in some specimens of the latter (from Cambridgeshire and Norfolk) when the tubercle is very strongly developed, a fact also observed by Fejervary * in the case of his var. *bolkayi* from Switzerland (= *lessonæ*). This character is correlative of the transformation of the tubercle into a fossorial organ, as already recognised by Wolterstorff, who fully admits the true state of things in the var. *chinensis*, from a diagnostic point of view, although unfortunately not acquainted with the amount of variation in the var. *lessonæ*. It has also been observed that the base of the tubercle of the var. *chinensis* does not run parallel to the axis of the longest toe, but is oblique to it; this is however only more or less so in the Chinese-Japanese frog, again in relation with the degree of development of the tubercle, and a similar disposition, varying in degree, is likewise to be observed in the var. *lessonæ*.

Although the metatarsal tubercle may be identical in the two varieties, I quite agree with Wolterstorff, and have always held the view that the var. *chinensis* cannot have been derived from the var. *lessonæ*, the two forms representing independent extremes in the parallel evolution of the same adaptive character; but the var. *lessonæ* is there to illustrate the steps through which the character has been evolved out of a type such as the var. *ridibunda*, now so completely separated from the easternmost form of *R. esculenta*. Wolterstorff seems to look upon the typical form, or rather its hypothetical direct ancestor, as the origin of the races in question; Bolkay, in my opinion, is nearer the truth when he suggests *R. ridibunda* being nearer to *R. chinensis*, but at the same time he inverts the drift of evolution in regarding the former as derived from the latter, owing to theoretical considerations based on the now exploded "præpollex" and "præhallux" theory.

In his description of *R. nigromaculata* (*chinensis*), Stejneger says the toes are about $\frac{3}{4}$ webbed. It is so in some cases, but rather the exception than the rule, and similar

* Beitr. Herp. Rhôneal, p. 20 (1909).

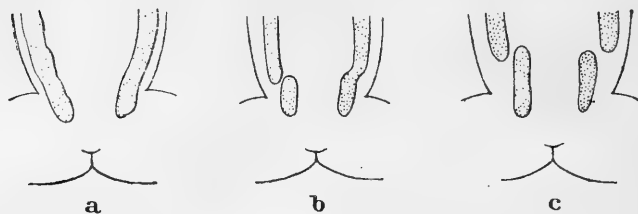
exceptions occasionally occur in the typical form (Poitiers, Bologna) and in the var. *ridibunda* (Alemeitejo, Majorca, Rahamna in Morocco). The outer metatarsals are separated nearly to the base in *R. esculenta*, only in their distal half in *R. temporaria* and *R. arvalis*, the other European species filling up the gap between the two extremes.

Integument and Markings.

The elongate glandules or interrupted longitudinal glandular folds on the back*, afford, generally speaking, a good distinctive character for the var. *chinensis*, but they may be very feebly marked or almost obsolete in some specimens (Kiu Kiang, Yokohama), and they are occasionally foreshadowed in the var. *ridibunda* (Beit Jenn, near Damascus), so that the two forms are completely connected in this respect.

I may point out another character, hitherto overlooked, which affords an absolutely constant distinction between the typical form and the var. *chinensis*.

Fig. 5.



Posterior extremities of dorso-lateral folds in specimens from Berlin, var. *ridibunda* (a), Cadillac, var. *ridibunda* (b), and Vienna, f. *typica* (c).

In the former, and also in the var. *lessonae*, the glandular dorso-lateral fold ends abruptly at some distance in front of the thigh, and it is often followed by a detached portion parallel with it but nearer to the mid-dorsal line and extending on the base of the thigh. In the var. *chinensis* the fold extends uninterrupted to the hip, or, if broken up posteriorly, without any deviation from the straight line. Now, this striking difference is completely bridged over when we take the var. *ridibunda*, as well as the var. *saharica*, into consideration. Some specimens have the fold continuous and

* A very variable feature in the American representative of *R. esculenta*, *R. halcina*, L.

extending to the hip (fig. 5, a), others have a detached posterior part as in the typical form (c), whilst others again (b) connect the two conditions, the posterior part of the fold, though deviating, being confluent with the anterior and forming a bend before reaching the thigh.

Bolkay mentions among the specific differences between *R. esculenta*, *R. ridibunda*, and *R. chinensis*, that the dorso-lateral fold is wider (as wide as the upper eyelid) in the second than in the two others. This character is absolutely worthless, for in specimens of the typical form from France and Switzerland its width usually measures $\frac{1}{2}$ to $\frac{2}{3}$ that of the upper eyelid, but may be equal to it (St. Malo, Havre, Basle, Zofingen), and in German and Austro-Hungarian specimens of the var. *ridibunda* $\frac{1}{2}$ to $\frac{3}{4}$ that width is by no means unfrequent. The fold is always narrower than the upper eyelid in the vars. *chinensis* and *lessoneæ*.

In my previous descriptions of the var. *ridibunda* I have drawn attention to the fact that the dorso-lateral fold, though usually broader than in the other forms, is less prominent; I should add that it is sometimes so flat that it cannot be traced without the use of a lens, when the pores with which it is studded indicate its course. It has not been pointed out however that these folds are rendered more inconspicuous still owing to the spots on the body being disposed quite irrespective of them, whilst in the typical form and the vars. *lessoneæ* and *chinensis* they stand out on account of their lighter colour, hardly ever encroached upon by the spots, which may be arranged more or less in relation to them, especially when forming longitudinal bands. When a specimen of the var. *ridibunda* is seen at a short distance there is usually nothing to reveal the presence of the dorso-lateral folds, which strike the eye in the typical form and the vars. *lessoneæ* and *chinensis*.

These facts have a bearing on the question of the derivation of the forms which constitute the species *R. esculenta*, and confirm the view I have held ever since I took up the study of the subject that the var. *ridibunda* is the most primitive form, out of which the others have been evolved. In a paper recently published* on the derivation of characters in the genus *Rana* as a whole, the absence of the dorso-lateral fold is considered by me as the primitive condition, and the North American *R. catesbiana*, in which it is totally absent, is, for this and other reasons, regarded as nearest the hypothetical prototype among all the species of Eurasia and

* Bull. Soc. Zool. France, 1918, p. 111.

America. Close to *R. catesbiana*, there is another North American species, *R. septentrionalis*, in my opinion derived from it, in which the fold is either present or absent, according to individuals, but when present is short and very flat, with the spots and marblings irregularly distributed over the body. Such a type leads to the state of things in *R. esculenta*, var. *ridibunda*.

Bolkay alludes to the transverse expansion of the dark spots on the back as an important character of *R. chinensis*, but such transverse markings are by no means the rule in this variety, some specimens of which are, on the contrary, longitudinally streaked, as is often the case in the typical form and the var. *lessonæ*, but never in the vars. *ridibunda* and *saharica*. I may here mention that specimens with the black markings forming cross-bars on the back are exceptionally met with, not only in the var. *ridibunda*, but also in the typical form (females from Rivoli and Verona).

The light vertebral streak or band is very frequent in the typical form and the vars. *lessonæ* and *chinensis*, less so in the var. *ridibunda*, in which it is generally broader, and usually absent in the var. *saharica*. I do not think this light vertebral streak, which occurs in so many species, is to be looked upon as a primitive character; the frequent cases of deviation of its course from the straight line (most strongly marked in specimens from Calcinaro and Cadillac) suggest a different interpretation, and, in the present state of our knowledge, its signification is highly problematic, as is that of a light line along the inner side of the upper surface of the leg which, in many Oriental and African species, often accompanies the vertebral streak, and exceptionally occurs in *R. esculenta*, var. *chinensis* (♂ from Japan). Both streaks are absent in all American species, with the single exception of *R. cantabrigensis*, Baird, the representative of the European *R. arvalis*, Nilss.

The Skull.

The osteological characters appealed to by Bolkay are evidently derived from an examination of a very small number of specimens; put to the test of a larger material they prove to be worthless for defining species.

I am especially surprised at his statements concerning the nasal and fronto-parietal bones. Although usually in contact with each other in full-grown specimens of the typical form, as described and figured by Ecker, Fatio, and others,

the nasal bones are not always so ; there are frequent exceptions, as my own description implies *, but such exceptions occur as well in the var. *ridibunda*, even in large specimens (♀ from Vienna, 90 mm. from snout to vent, ♀ from Prague, 120 mm.), and I have come across adults of the var. *chinensis* in which the nasal bones are completely separated from each other, as is usually the case in immature or small specimens of all the forms. As to the presence or absence of the anterior notch between the frontoparietals, this is a mere individual peculiarity, usually dependent on the size of the specimen ; yet I wish to draw attention to the figures given by Camerano † of small specimens of the var. *lessonæ* from Italy in which the anterior extremity of the frontoparietals answers to Bolkay's definition of *R. chinensis*.

The Size.

I append the measurements, from snout to vent, of the largest specimens of the different forms in the British Museum. According to Werner ‡, the var. *ridibunda* may reach a length of nearly 150 mm. in Austria.

	♂.	♀.
Var. <i>ridibunda</i>	95 mm.	125 mm.
Var. <i>saharica</i>	58	80
F. <i>typica</i>	78	95
Var. <i>lessonæ</i>	64	78
Var. <i>chinensis</i>	70	85

The Tadpole.

I have examined large series of tadpoles of the vars. *ridibunda* and *chinensis* without succeeding in finding any characters by which to distinguish them from those of the typical form. The characters pointed out by Annandale § for the var. *chinensis* are not confirmed as regards the mouth-disc, the position of the spiraculum, or the length of the tail compared to that of the body.

Conclusions.

When dealing with polymorphic species, botanists often distinguish between forms (species, some term them) of first, second, third, and fourth rank. Applying this concept to *Rana esculenta*, the typical form representing of course the

* Taill. Batr. Eur. p. 279.

† Mem. Acc. Torin. (2) xxxv. 1883, p. 60.

‡ Rept. Amph. Oesterr.-Ung. p. 88 (1897).

§ Mem. As. Soc. Beng. vi. 1917, p. 147.

first grade, we may place the var. *chinensis* in the second, the var. *ridibunda* in the third, and the vars. *saharica* and *lessonæ* in the fourth. Looking at things from a practical standpoint, we must regard the var. *saharica* as but a slight modification, a geographical race distinguishable from its nearest neighbour but impossible to define if specimens from the whole range of distribution of the var. *ridibunda* are taken into consideration. The typical form is completely connected with the var. *ridibunda*, and where the two co-exist in a locality, annectant individuals may be regarded as the result of crossing, such as undoubtedly must take place; but this explanation fails when we have to deal with specimens from France, S.E. Europe, and Asia, where individuals of uncertain identification likewise occur, although the discrimination of the two forms is in most cases quite easy. It is no longer so when we come to the typical form compared with the var. *lessonæ*, and in this case the naming of certain specimens is perfectly arbitrary, as those who have had to deal with a considerable material from places where the two forms co-exist fully admit*; yet, the extreme, what some would call the "pure *lessonæ*," such as it occurred in the Cambridge fens and is still found in a very few localities in Norfolk, is well entitled to varietal rank, its structural characters being fixed and so considerable in degree when compared with the typical form that it would undoubtedly be looked upon by many as a species were we not acquainted with the annectant examples from the Continent. These extreme specimens of the var. *lessonæ* represent the terminus of an uninterrupted series starting from the var. *ridibunda* and passing through what is called the typical form.

Another terminus form, in which the principal characters of the var. *lessonæ* are repeated, is the var. *chinensis*, which in all probability is also derived from the var. *ridibunda*, but the connecting-links of which have disappeared or are still unknown. If we appeal to the existence of a hiatus between forms as a sole criterion for deciding on what is a species, then *R. chinensis* is entitled to stand as such; however, considering the many points of agreement, and preferring to keep an eye on resemblances rather than on differences, the rank of variety or subspecies appears to me the more appropriate for this form, as it did to Lataste many years ago†. Owing to the state of things in the

* Cf. Wolterstorff, Schr. Nat. Ges. Danzig, (2) xi. 1904, p. 46.

† Bull. Soc. Zool. France, 1880, p. 61. "Cette forme, que quelques auteurs regardent comme une espèce distincte, d'autres comme une

European forms, the course I have followed is surely the better from a philosophical point of view, whilst the use of a varietal designation precludes all fear of the distinction being overlooked.

The following diagram expresses the relationship between the five forms, as I conceive them :—



We cannot yet apply the test of crossing experiments in justification of the subordinate position assigned to *R. chinensis*, as Pflüger was able to do in the case of *R. esculenta* and its var. *ridibunda*, but another physiological argument has been put forward by Wolterstorff: the large and often sharp-edged metatarsal tubercle of *R. chinensis* is an adaptation to burrowing habits unlike those of *R. esculenta*. We are told that Dr. Kreyenberg observed the Chinese frog to dig and retire deep into the ground of dried-up rice-fields, and this habit is regarded as an important ethological differentiation from its European representatives. Curiously, however, Fájervary very shortly after redescribed the var. *lessonæ* under the name of var. *bolkayi*, from specimens living in marshes at the mouth of the Rhône in Switzerland, and observed the behaviour of this frog on land to be different from that of the typical *R. esculenta*, the large and somewhat movable metatarsal tubercle being used to burrow in the ground after the manner of *Pelobates*. It is interesting to note, in this connection, that Wolterstorff, who (1906) seemed to attach so great an importance to this peculiarity in the case of the Chinese frog, had (1904) only reluctantly recognised *R. lessonæ*'s rank as a variety, a term which for him expresses mere individual variations, such as his colour-

simple variété de *Rana esculenta*, L., a des caractères propres et constants qui lui méritent une description particulière et un nom spécial; elle me semble cependant assez voisine de *Rana esculenta* pour que je crois utile de ne l'en point séparer spécifiquement Et si, après quelques hésitations, je me décide à classer [*R. chinensis*] comme sous-espèce de *R. esculenta*, c'est par cette seule considération qu'elle me paraît beaucoup plus voisine de cette dernière que de toutes les autres grenouilles."

varieties *striata* and *nigromaculata* in *R. arvalis**, and refused to admit it as a subspecies.

These observations on the fossorial habits of the vars. *chinensis* and *lessonæ* should be borne in mind by those who appeal to the behaviour of the Indian *R. crassa*, compared to that of the typical *R. tigrina*, as an argument in favour of its specific distinction†. These supposed species offer a perfect parallel to the lines of evolution which can be traced in *R. esculenta*, as I have recently pointed out‡.

Although we must not expect to find among the species of the present day the actual types out of which their allies have been evolved, yet I think it legitimate speculation to look upon certain species, or certain small groups of species, as a sufficiently near approximation to help us towards an elucidation of the phylogenetic relationships, the expression of which should be the aim of taxonomy. In this sense, and with this reservation, I consider *R. catesbiana*, Shaw, and *R. grylio*, Stejn., as representing the most primitive forms of America and Eurasia; the species that cluster round them, *R. septentrionalis*, Baird, *R. clamitans*, Daud., *R. onca*, Cope, *R. virgatipes*, Cope, *R. montezumæ*, Baird, would be derived from the same stock; they constitute a distinct section, which is perfectly natural, though not susceptible of a very strict definition. From this section we may imagine the one of which *R. esculenta* is the type to have been derived, and there is little doubt in my mind that the Chinese *R. plancyi*, Lataste, is a connecting form, nearly allied to, but in most respects less modified than, *R. esculenta*, both having been evolved out of the same ancestor, possibly related to the Oligocene-Miocene *R. meriani*, H. von Mey. The chief distinctive features of *R. esculenta* compared to *R. plancyi* reside in a reduction of the nasal bones, the more obtuse fingers, and the very peculiar external vocal sacs. By what steps this last

* Such modifications represent varieties only in the sense taken by horticulturists, and should not be given names in scientific nomenclature. Eliminating these cases, I apply the term *varietas* to every division of the system subordinate to the species, without any further consideration of hierarchy, in order to avoid complicating nomenclature by the use of tri-, quadri-, or even quinquenomials. In so doing, I simply adhere to the Linnean method which has so long been followed, and is still used by most of the botanists for whose work I have the greatest respect. "Les variétés des systématistes sérieux sont les espèces de M. Jordan, au moins du Jordan des *Observations* et du *Pugillus* Le mot variété employé par les botanistes pour désigner une race sauvage laisse peut-être à désirer, mais il jouit de la priorité." J. Briquet, Questions de Nomenclature, Bull. Herb. Boissier, ii. 1894, p. 84.

† Annandale, Rec. Ind. Mus. xv. 1918, p. 63.

‡ Rec. Ind. Mus. xv. 1918, p. 51.

character was reached, *R. halecina*, L., is there to show us, for within the limits of this highly variable species, the vocal sacs may be said to be still in process of evolution ; situated behind the commissure of the jaws, as in *R. esculenta*, *R. montezumæ*, *R. areolata*, B. & G., and *R. capito*, Leconte, but unlike those of all other frogs, they are either internal or external, showing every degree of development, and when external they form folds which, in certain individuals, have a tendency towards the invagination characteristic of the sacs in *R. esculenta*. We may well assume the direct ancestors of *R. esculenta* to have passed through such stages in the course of parallel evolution.

XXVIII.—*Contributions to a further Knowledge of the Rhynchotal Family Lygæidæ.* By W. L. DISTANT.

[Continued from p. 179.]

Lygæus degeni, sp. n.

Head, pronotum, scutellum, corium, and body beneath griseo-fuscous, two small central spots on pronotum, two larger spots on clavus, and two still larger spots on corium—one on each side of claval apex—black ; basal third of lateral margin to corium, connexivum beneath, and legs pale testaceous or ochraceous ; membrane pale fuscous, narrow base, lateral margins, and an irregular discal, transverse, angulated spot greyish white ; antennæ ochraceous, the apical joint fuscous, second joint a little longest, third and fourth joints subequal in length ; pronotum and scutellum centrally longitudinally carinate ; the upper surface is more or less finely and obscurely very shortly pilose.

Long. 8 mm.

Hab. Abyssinia ; Taddecha, Mullka (*Degen*).

EXOPAMERA, gen. nov.

Head robust, about as long as broad ; eyes projecting beyond the anterior angle of pronotum but not reaching its anterior margin ; antennæ with the basal joint stoutest and considerably passing apex of head, second joint longest ; rostrum with the basal joint not quite reaching base of head, its apex scarcely passing the anterior coxæ ; pronotum

elongate but very little longer than broad at base, lateral margins narrowly laminately carinate, anterior collar very narrow, subobsolete, anterior much longer than posterior lobe, convex, its lateral margins rounded, lateral margins of the posterior lobe obliquely straight; scutellum longer than broad, subtriangular; anterior femora thickened, spined beneath, anterior tibiæ distinctly curved, their apices dilated and inwardly a little angulâte, intermediate and posterior tibiæ moderately spinulose.

Type, *E. æthiopica*, Dist.

Allied to *Pseudopamera*, Dist., from Central America.

Exopamera æthiopica, sp. n.

Head black, moderately shortly palely pilose; eyes darker black; ocelli purplish red; pronotum ochraceous, the lateral and anterior margins and the posterior lobe paler in hue, punctate, especially the posterior lobe, the basal margin and lateral basal angles more or less shining black; scutellum ochraceous, basal and apical areas black, more or less coarsely punctate; corium ochraceous, clavus more or less closely blackly punctate, two prominent spots before claval area, an irregular transverse subapical spot, and the apical angle shining black, the whole corium more or less coarsely punctate; membrane black, its apical margin pale fuliginous; head and abdomen beneath opaque black; sternum shining black and coarsely punctate; coxæ, trochanters and legs, narrow lateral sternal margins and posterior sternal segmental margins ochraceous; rostrum ochraceous; membrane moderately passing the abdominal apex; antennæ with the first, second, and third joints ochraceous, their apices black, fourth joint greyish white, its apical half black, second joint longest, third and fourth joints almost subequal in length.

Long. 9-10 mm.

Hab. Brit. E. Africa; Kibwesi (*S. A. Neave*).

Exopamera mirabilis.

Aphanus mirabilis, Dist. Ann. Mag. Nat. Hist. (7) xii. p. 471 (1903).

Hab. Fernando Po.

ALBANYARIA, gen. nov.

Body elongate; head subtriangular, apical area distinctly narrowed and apex of central lobe distinctly prominent;

eyes moderately prominent and slightly passing the anterior angles of the pronotum; antennæ moderately robust, basal joint only a little passing apex of head; rostrum with the basal joint almost reaching base of head; pronotum a little longer than broad at base, and transversely constricted near base; corium extending only to about three-fourths of the abdomen; membrane absent; anterior femora incrassated and finely spined beneath; anterior tibiæ a little curved but not centrally spined; scutellum elongate, longer than broad.

Allied to *Fontejus*, Stål, but the pronotum much shorter, anterior tibiæ not centrally spined, &c.

Albanyaria multicolorata, sp. n.

Head, anterior lobe of pronotum, and the scutellum black; the narrow posterior pronotal lobe and the extreme apex of scutellum greyish white; antennæ ochraceous, apex of third joint and more than apical half of fourth black; corium ochraceous, the lateral marginal areas with three prominent black spots, the smaller near base, the largest near middle, and the third at apex, the exposed apical area of the abdomen black; body beneath black; posterior sternal segmental margins very pale ochraceous; legs reddish ochraceous, apical halves of the anterior femora and apices of the tibiæ and tarsi black; antennæ with the second joint slightly longer than the third and about subequal with the fourth; scutellum more or less rugosely punctate; clavus linearly somewhat coarsely punctate; rostrum ochraceous, the basal joint black, remaining joints imperfectly seen in *carded* type.

Long. $5\frac{1}{2}$ mm.

Hab. W. Australia; Albany (*J. J. Walker*).

Genus LARYNGODUS.

Laryngodus, Herr.-Schæff. Wanz. Ins. ix. pp. 191, 212 (1853).

The short description given by Herrich-Schæffer and some imperfections in the figure given of the type of the genus render a fuller description of both necessary.

Laryngodus australiæ, Herr.-Schæff. Wanz. Ins. ix. p. 212, fig. 967 (1853).

Head fuscous brown; eyes black; antennæ dark castaneous, apices of the first, second, and third joints very

narrowly black, fourth joint ochraceous with nearly apical third black; head and anterior lobe of pronotum fuscous brown, posterior pronotal lobe black, with two central spots and the lateral margins creamy white or very pale ochraceous; eyes black; scutellum fuscous brown; corium dull ochraceous, darkly punctate, inner area of clavus more densely darkly punctate, disk of corium with an oblique longitudinal fascia—neither reaching base nor apex, a sub-central, transverse, very irregular fascia, and the apical angle, black; membrane fuscous, the veins, and some irregular suffusions and spots, pale dull ochraceous; body beneath and legs dark castaneous, basal spine to antennæ beneath, anterior margin of prosternum, coxæ, posterior angles of meso- and metasterna, and the greater part of basal joints of intermediate and posterior tarsi pale ochraceous.

Head elongate, longer than basal breadth including eyes, narrowed on apical area, and with a short spine at base of antennæ; eyes prominent, almost reaching base of head; antennæ with the basal joint shortest and stoutest, second joint a little longer than third, which is again longer than fourth; pronotum punctate, with anterior lobe much narrower, more globose, and about twice as long as the posterior lobe which is more strongly punctate, anterior lobe with a central, longitudinal, fasciate, flat impression; scutellum about as broad as long, subtriangular, thickly punctate, extreme apex ochraceous; corium broadened on apical area; membrane with the venation very prominent; anterior femora strongly thickened, narrowed at base and apex, distinctly spined beneath; anterior tibiæ flattened and sub-spinosely dilated at apices; rostrum about reaching the intermediate coxæ.

Long. 10 mm.

Hab. S.W. Australia; Yallingup (*R. E. Turner*).

Bosbequius australis, sp. n.

Head, anterior area of pronotum, scutellum and sternum, black or blackish; anterior margin and posterior area of pronotum and corium brownish ochraceous; lateral pronotal margins and a spot near inner angle of apical margin to corium very pale luteous; abdomen beneath brownish ochraceous; femora castaneous, their apices and the tibiæ and tarsi ochraceous; antennæ dull ochraceous, second joint longest, first joint slightly passing apex of head* ; head

* In the typical Oriental species the basal antennal joint did not reach the apex of head.

(including eyes) narrower than anterior margin of pronotum ; first joint of rostrum extending beyond base of head ; posterior area of pronotum, scutellum and corium coarsely punctate ; anterior femora strongly incrassate.

Long. 8 mm.

Hab. Australia ; Adelaide River (*J. J. Walker*).

The type of the genus *Bosbequius* was from Tenasserim (Faun. Brit. Ind., Rhynch. ii. p. 65, fig. 1).

Thebanus nigrinus, sp. n.

Dull ochraceous ; head, anterior lobe of pronotum, and anterior area of scutellum black ; head beneath and sternum black ; legs ochraceous ; abdomen beneath dark slaty-grey ; antennæ ochraceous, second joint a little longest, third and fourth almost subequal in length ; pronotum thickly, somewhat coarsely punctate ; scutellum punctate, black before the anterior branches of the cruciform carination, and dull ochraceous behind them ; posterior margin of pronotum concave before scutellum ; corium (excluding lateral marginal areas) darkly punctate ; membrane slaty-grey, slightly passing the abdominal apex.

Long. $3\frac{1}{2}$ mm.

Hab. Burma ; Karennee.

GENUS LACHNOPHOROIDES.

Lachnophoroides, Dist. 'Nova Caledonia,' Zool. i. p. 381 (1914).

Type, *L. ornatipennis*, from New Caledonia (ibid. pl. xi. fig. 9 ♀).

I am now able to amplify the description of this genus by sexual characters, having only seen a single ♀ specimen previously.

♂. Pronotum distinctly longer than breadth at base ; anterior tibiæ strongly sinuately curved and armed with a short robust spine near middle of under surface.

♀. Pronotum about as long as broad at base ; anterior tibiæ unarmed.

Lachnophoroides crudelis.

Pachymerus crudelis, Hagl. Öfv. Vet.-Akad. Förh. 1895, p. 462.

Hab. W. Africa ; Gaboon (fide *Haglund*). Lagos ; Onlo (*A. B. S. Powell*). N.E. Rhodesia ; Upper Luangwa R. (*S. A. Neave*). Uganda Protect. between Junja and Busia, E. Busoga (*S. A. Neave*). Abyssinia (Lake Rudolph Exped.—*Ph. C. Zaphiro*).

Lachnophoroides rudolfianus, sp. n.

Head and anterior lobe of pronotum dull, dark ochraceous, posterior pronotal lobe paler ochraceous with darker punctures in somewhat transverse series and with three central longitudinal darker series, lateral margins broadly and basal margin narrowly pale ochraceous, a black spot near each basal angle; scutellum ochraceous, darkly punctate, a large castaneous spot at base and two linear black spots on apical area; corium very pale ochraceous, more or less darkly punctate, clavus with a black and greyish spot at base, beyond middle of corium a broad transverse dark castaneous fascia and the apical margin narrowly and irregularly of the same colour; membrane pale shining ochraceous; head beneath and sternum piceous; abdomen beneath dull dark testaceous; legs and rostrum ochraceous; antennæ ochraceous, apices of the second and third joints and apical half of the fourth black, second joint a little longest, third and fourth joints subequal in length; anterior femora robust, strongly spined beneath near apex, anterior tibiæ in ♂ strongly curved, and with a prominent spine beneath near middle.

Long. 8 mm.

Hab. Soudan; Kaig (Lake Rudolph Exped.—C. Singer).

Aphanus littoralis, sp. n.

Head black or very dark castaneous, eyes griseo-fuscous; antennæ dull ochraceous, apices of first, second, and third joints more or less fuscous, fourth joint dark fuscous with a broad subbasal greyish annulation; pronotum ochraceous, prominently brownly punctate, the lateral margins almost impunctate, anterior half (excluding margins) dark castaneous and almost impunctate, with a small central pale ochraceous spot at anterior margin; scutellum ochraceous, prominently brownly punctate, the basal area black; corium ochraceous, rather finely brownly punctate, extreme lateral margins almost impunctate; membrane brownish ochraceous with somewhat paler mottlings; body beneath castaneous, the lateral margins, posterior sternal segmental margins, rostrum, and legs ochraceous, the lateral abdominal margin with large castaneous spots; second, third, and fourth joints of antennæ gradually decreasing in length, the second a little longest; first joint of rostrum about reaching base of head; membrane about reaching abdominal apex; pronotum with a more or less distinct central

longitudinal narrow carination ; scutellum a little foveately depressed at base.

Long. $8\frac{1}{2}$ –10 mm.

Hab. Blue Nile (*E. S. Cressin*), nr. mouth of Dinder R. and Roseires (*S. S. Flower*). N.W. shore of L. Nyasa, from Florence Bay to Karonga (*S. A. Neave*).

Aphanus ferrugineus, sp. n.

Head black ; antennæ with the basal joint black, second and third joints ferruginous ; pronotum pale ferruginous, coarsely darkly punctate, the anterior area (excluding margins) black ; scutellum black, coarsely darkly punctate, becoming paler and more ferruginous on apical area, and with an ochraceous spot on each lateral margin near base ; corium brownish ochraceous, darkly punctate, with two small obscure black spots in oblique series on apical half, the lateral margins narrowly impunctate ; body beneath black, the posterior sternal segmental margins, rostrum, and legs ferruginous ; second joint of antennæ considerably longer than third ; apex of central lobe of head distinctly prominent ; in some specimens the femora are distinctly darker—almost black—than the tibiæ ; basal joint of rostrum passing base of head ; membrane, a little paler than corium, reaching abdominal apex.

Long. 8 – $8\frac{1}{2}$ mm.

Hab. Nyasaland (*Cotterell*) ; W. shore of L. Nyasa between Domira Bay and Kotakota (*S. A. Neave*). N.E. Rhodesia ; Mid-Luangwa Valley (*S. A. Neave*).

Aphanus apicalis.

Rhyparochromus apicalis, Dall. List Hem. ii. p. 562 (1852).

Rhyparochromus turgidifemur, Stål, Öfv. Vet.-Ak. Förh. 1855, p. 32. 1.

Rhyparochromus nigromaculatus, Stål, Öfv. Vet.-Ak. Förh. 1855, p. 32. 2.

Beosus apicalis, Stål, Hem. Afr. ii. p. 165 (1865).

Aphanus erosus, Dist. Ann. & Mag. Nat. Hist. (7) viii. p. 501 (1901).

In describing my *A. erosus* I wrote, " Allied to *A. apicalis*, Dall., differing by the exceedingly coarse punctuation on the lateral margins of the pronotum and corium, &c." Compared with the type of Dallas, that held good at the time of writing, but since then a large number of species have reached the British Museum, and intermediate varieties occur.

Hab. S. Africa (Brit. Mus.). Ovampo L. (*Eriksson*).

Transvaal; Pretoria (*Distant*), Lydenburg (*Krantz*). N.E. Rhodesia; Mid-Luangwa Valley (*Neave*). Blue Nile; Roseires (*Flower*). Congo (*Richardson*).

*Aphanus albiger*a, sp. n.

Head and anterior area of pronotum black, posterior pronotal area ochraceous, brownly punctate, and at the lateral marginal junctions of these two areas a somewhat large pale ochraceous spot; scutellum black; corium ochraceous, thickly darkly punctate, extreme lateral margin impunctate, inner claval margin for about half its length from base pale ochraceous and impunctate, from thence to apex very thickly blackly punctate, a short elongate black line near outer claval margin, followed by a large black spot near and outside claval apex, the apical margin of corium narrowly black, the two last markings separated by a small pale impunctate spot; membrane brownish with the venation somewhat paler in hue; body beneath, rostrum, and legs black, coxal spots and narrow, irregular posterior margins to sternal segments pale ochraceous; antennæ with the third joint shortest, second and fourth subequal in length.

Long. 6-6½ mm.

Hab. South Africa; Grahamstown. Natal; Durban (*F. Muir*).

Allied to *A. apicalis*, Dall., but a smaller and narrower species, markings of the pronotum and short third joint of antennæ different.

Aphanus nigrellus, sp. n.

Head, antennæ, pronotum, and scutellum black, lateral pronotal margins ochraceous; corium dull ochraceous, two short claval lines and the apical area black, the latter containing a prominent, central, transverse greyish-white spot, and the extreme apical angle also of that colour; membrane griseo-fuscous, with an apical white spot; body beneath, rostrum, and legs black; antennæ somewhat robust, third joint a little shorter than second or fourth joints; pronotal lateral margins distinctly, somewhat longly pilose.

Long. 6 mm.

Hab. Nyasaland; between Ft. Mangoche and Chikala Boma (*S. A. Neave*).

Allied to both *A. apicalis*, Dall. and the preceding species here described—*A. albiger*a, but differing by the colour of the pronotum and its longly pilose lateral margins, &c.

MAXAPHANUS, gen. nov.

Allied to *Aphanus*, Lap., from which it differs by the longer and more elongate body; the longer and more robust basal joint of the antennæ, which is as long as the head and projects considerably beyond its apex; anterior femora shortly spined beneath, with a long and very distinct spine before apex, anterior tibiæ also shortly spined beneath beyond base.

Maxaphanus africanus, sp. n.

Dark castaneous, in some specimens almost piceous; lateral margins (excluding basal areas) of pronotum and sometimes a small central spot to same, corium with about basal half of lateral margin, a small lateral spot beyond it and nearer apex, a small discal spot outside the apical claval area and a minute spot before posterior margin, extreme apex of scutellum, rostrum and legs, ochraceous; apical areas of femora and the tibiæ and tarsi darker and more brunescent; antennæ dark castaneous, fourth joint (excluding apical area) pale ochraceous, second and third joints almost subequal in length and longest, fourth longer than first which considerably passes the apex of head; pronotum distinctly, broadly, transversely impressed near middle, the anterior area smooth, the posterior area finely wrinkled, lateral margins distinctly laminate; corium distinctly punctate; membrane pitchy-brown, the veins prominent, the two inner veins strongly curved at base.

Long. 13-14 mm.

Hab. Nyasaland; Mlanje (*S. A. Neave*). N. E. Rhodesia; Upper Luangwa R. (*S. A. Neave*). Uganda; Tero Forest (*C. C. Gowdey*), Entebbe (*C. A. Wiggins*).

Metochus holsti, sp. n.

Head, anterior lobe of pronotum, and scutellum black, posterior pronotal lobe piceous, darkly punctate, and with a pale central longitudinal line; corium ochraceous, clavus, a broad irregular transverse fascia connecting apex of clavus with lateral margin, and the apical margin black, the anterior area between the clavus and lateral margin is ochraceous, brownly punctate, the area between the transverse fascia and apex creamy-white; membrane fuscous with obscure paler mottlings; head beneath and sternum black; abdomen beneath dark castaneous, with some lateral

marginal ochraceous macular markings ; rostrum ochraceous, basal and apical joints piceous ; femora black, their bases and the whole of the tibiæ and tarsi more or less ochraceous ; antennæ piceous, basal half of apical joint ochraceous, second joint longest, third and fourth almost subequal in length ; anterior femora robust, shortly spinose beneath.

Long. 10 mm.

Hab. Japanese Archipelago ; Tsushima Island (*P. Holst*).

Dieuches irelatus, Dist. Ann. & Mag. Nat. Hist. (7) viii. p. 505 (1901).

Hab. Mashonaland ; Umfili River (*G. A. K. Marshall*). Nyasaland ; Valley of N. Rukuru, Karonga District (*S. A. Neave*). Uganda ; Entebbe (*C. C. Gowdey*). Abyssinia ; Gibe River (*Ph. C. Zaphiro*).

The type was from Mashonaland.

Dieuches parvipictus, sp. n.

Head, pronotum, and scutellum black ; anterior half of lateral margins and some small spots (usually two but sometimes four) on disk of pronotum, two spots near base and extreme apex of scutellum ochraceous ; antennæ ochraceous, apex of third joint black, more or less mutilated in the twelve specimens now before me ; corium ochraceous, brownly punctate, extreme lateral margins pale and impunctate, a spot at base of clavus, a large spot near inner posterior angle, a very small spot in a line with it on lateral margin, and the apical margin black ; body beneath black : rostrum and legs ochraceous, apex of rostrum and usually apical areas of the femora—more or less—black ; antennæ with the second and third joints almost subequal in length ; scutellum with a more or less distinct, central, longitudinal carinate line.

Long. 7–8 mm.

Hab. Katanga ; Kambove and Luffra River (*S. A. Neave*).

Allied to *D. patruelis*, Stål, but a smaller species with both the pronotal lobes black.

Dieuches consimilis, sp. n.

Allied to the preceding species in general markings and coloration, but a larger species with the basal joint and apices of the remaining antennal joints black ; posterior pronotal lobe more strongly and coarsely punctate ; scutellum

without the central carinate longitudinal line which is always more or less pronounced in *D. parvipictus*.

Long. 9-10 mm.

Hab. Uganda; Entebbe (C. C. Gowdey). Katanga; Kambove (S. A. Neave). Abyssinia (C. Singer).

Dieuches smithi, sp. n.

Head and anterior lobe of pronotum testaceous, posterior pronotal lobe ochraceous, thickly darkly punctate, lateral pronotal margins pale, impunctate; scutellum testaceous, extreme apex pale ochraceous; corium dark ochraceous or brownish ochraceous, lateral margins and a large irregular spot before apex pale ochraceous; membrane brownish ochraceous; body beneath testaceous; lateral margins of sternum, posterior margin of metasternum, and lateral abdominal margins ochraceous; rostrum and legs ochraceous, apical areas of femora and apices of the tibiae piceous; antennae ochraceous, the basal joint and apices of remaining joints dark testaceous or piceous, second and fourth joints longest and subequal in length; pronotum with a central longitudinal carinate line on posterior lobe; first joint of rostrum about reaching base of head; membrane not quite reaching abdominal apex in ♂, distinctly shorter in ♀.

Long. 10-11 mm.

Hab. S. Africa (Dr. Smith's Coll.). Graham's Town (F. Pym).

Allied to *D. umbrifer*, Stål.

Dieuches sloggetti, sp. n.

Black; lateral margins of pronotum and corium, second joint and base of third joint of antennae (fourth joint mutilated), tibiae and tarsi stramineous or pale ochraceous; second joint of antennae much longer than third; pronotum somewhat narrow and elongate, posterior lobe thickly punctate; corium and clavus more or less thickly punctate; first joint of rostrum about reaching base of head.

Long. 9 mm.

Hab. S. Africa; Deelfontein (Col. Sloggett).

METADIEUCHES, gen. nov.

Head robust, about as long as breadth between eyes, which almost reach anterior margin of pronotum or are not far removed from same, in front of eyes laterally strongly obliquely sinuate, the apex of the central lobe prominent;

antennæ with the basal joint moderately stoutest, slightly apically curved, shorter than second joint which again is a little shorter than third, fourth almost subequal in length to first; rostrum reaching the anterior coxæ; pronotum elongate, longer than breadth at base, lateral margins of anterior lobe slightly oblique, those of the posterior lobe more prominently oblique, the posterior angles subnodulose, basal margin almost truncate, very slightly concave, anterior margin truncate; scutellum moderately long and slender, slightly longer than broad at base, lateral margins straightly oblique; legs elongate, anterior femora finely spined beneath, anterior tibiæ slightly dilated at apex; membrane passing abdominal apex.

Type, *M. dispar*, Hagl.

Metadieuches dispar.

Dieuches dispar, Hagl. Öfv. Vet.-Akad. Förh. 1895, p. 460.

Hab. Gaboon (*Sjöstedt*). Cameroons (*Escalera*). Uganda; Entebbe (*Dr. C. A. Wiggins and C. C. Gowdey*), Mwera, Kyanja, Mabira Forest, Katanga River (*C. C. Gowdey*), shores of L. Isolt or Wamala, 3800 ft., and S. of L. George (*S. A. Neave*).

Poeantius variegatus, sp. n.

Head and anterior lobe of pronotum black; posterior lobe of pronotum dark castaneous and coarsely punctate, the anterior and posterior lobes separated by a transverse ochraceous fascia; scutellum black; corium ochraceous, a longitudinal fascia in clavus, and nearly the apical half of corium black, the latter containing a narrow transverse pale ochraceous fascia a little beyond its middle; membrane dull greyish; head beneath and rostrum dull, dark castaneous, posterior margin of metasternum more or less greyish white; abdomen beneath black; legs black, apices of anterior and intermediate femora and the anterior tibiæ ochraceous; (posterior legs mutilated in type); antennæ with the basal joint ochraceous, second and third joints black, second a little longer than third (fourth joint mutilated in type); head deflected, immersed to eyes, a little longer than broad; pronotum with a central longitudinal, ill-defined carinate line; scutellum a little longer than broad; rostrum about reaching the intermediate coxæ.

Long. $6\frac{1}{2}$ mm.

Hab. Gaza Land; near Chirinda Forest (*G. A. K. Marshall*).

Lethæus longirostris.

Lethæus longirostris, Reut. Ent. Tidskr. viii. p. 102 (1887).

Hab. Madagascar (fide *Reut.*). Rodriguez (*Gullion*). Natal (*Bell-Marley*). N.E. Rhodesia; Lower Luangwa River, near Petauke, N.W. shore of L. Nyasa (*S. A. Neave*).

This species is variable in size; specimens now before me in length range between 9 and 12 mm.

Lethæus descriptus.

Rhyparochromus descriptus, Walk. Cat. Het. v. p. 103 (1872).

Rhyparochromus alienus, Walk. tom. cit. p. 105.

Lethæus signatus, Dist. Ann. & Mag. Nat. Hist. (7) viii. p. 506 (1901).

Lethæus descriptus, Dist. Faun. Brit. Ind., Rhynch. ii. p. 89 (1904).

Hab. N. India. Ceylon. Tenasserim. North Borneo. Sula Island. Natal; Durban (*Bell-Marley*). N.E. Rhodesia; Upper Luangwa River (*S. A. Neave*).

We are now able to record the distribution of this species (previously only known from the Indian and Malayan regions) to the southern Ethiopian habitats of Natal and Rhodesia.

Bergroth (Phil. Journ. Sci. xiii. p. 95 (1918)) has devoted nearly three large octavo pages to the description of a species from the Philippine Islands (*L. robustus*) which is apparently to be separated by the longer rostrum, "reaching middle of third ventral segment." In *descriptus* the rostrum only extends to about the posterior coxæ as described by Walker.

Genus ABANUS.

Abanus, Dist. Faun. Brit. Ind., Rhynch. v. p. 81 (1910).

In describing the type of this genus from specimens received from Bengal, I wrote "pronotum elongate, about as long as broad at base." This character from an examination of a series of specimens of another species received from tropical Africa appears to be of a sexual (female) character only, while in the male the pronotum is considerably longer than broad at base.

Abanus ugandensis, sp. n.

Head and anterior lobe of pronotum black, basal area of pronotum brownish ochraceous, blackly punctate, and with a central ill-defined pale levigate longitudinal line, lateral pronotal margins pale ochraceous; scutellum black, punctate, elongate, with two small discal spots and the extreme apex

ochraceous; corium very obscure ochraceous, thickly black punctate, the lateral margins pale ochraceous, apical margin more distinctly black; membrane dark fuliginous, sometimes with small ochraceous suffusions; apical area of abdomen above—as seen beyond membrane—black, the apical margin dull ochraceous; body beneath black, narrow lateral sternal and abdominal margins, very narrow posterior margin of prosternum, coxal margins, rostrum and legs, ochraceous; antennæ ochraceous, extreme apices of first and second joints, apical third of third joint, and fourth joint, excluding broad basal annulation, black, first joint passing apex of head, second longest, third and fourth subequal in length; rostrum reaching the intermediate coxæ, first joint about reaching or slightly passing base of head; prosternum thickly, coarsely punctate at base.

Long. 9–10 mm.

Hab. Uganda; Mabira Forest, Chagwe, Tero Forest (C. C. Gowdey), Entebbe (C. A. Wiggins), Mpumu (Miss M. Robertson). Katanga (S. A. Neave).

Genus GONATAS.

Gonatas, Dist. Biol. Centr.-Amer., Rhynch. i. p. 219 (1882); Faun. Brit. Ind., Rhynch. ii. p. 89 (1904).

This genus, originally described from Central America and subsequently received from the Oriental Region, is now also represented by a species from Natal.

Gonatas natalensis, sp. n.

Head black; antennæ with the first and second joints stramineous, remaining joints mutilated in type; pronotum with the anterior area black, posterior area ochraceous; scutellum black; corium dull greyish white, clavus pale ochraceous; membrane dull greyish white; body beneath black; rostrum and legs pale ochraceous, apical abdominal segment castaneous; head including eyes scarcely narrower than anterior margin of pronotum, which is distinctly strongly darkly punctate on the pale posterior area, its lateral margins moderately amplified and slightly sinuate at the junction of the anterior and posterior areas, its posterior margin distinctly moderately concave; scutellum longer than broad, moderately elevated, and distinctly foveate on the basal area, basal and lateral margins punctate; membrane reaching the abdominal apex.

Long. $5\frac{1}{2}$ mm.

Hab. Natal; Durban (Bell-Marley).

XXIX.—*The Myth of the Ship-holder**: *Studies in Echeneis or Remora*.—I. By E. W. GUDGER, State Normal College, Greensboro, N.C., U.S.A.

[Plates XV.—XVII.]

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INTRODUCTION.

Ever since the time of Aristotle, the ship-holder or sucking-fish, because of its peculiar structure and habits, has greatly interested men both scientific and unscientific. Possessed of a suctorial disk on the head and the shoulder region, it is able to attach itself to whales, porpoises, turtles, rays, and sharks, or to large fishes of any kind, and thus secure transportation and opportunity to obtain food without exertion. It likewise attaches itself to boats, ships, floating wrecks, or even logs in the same way and for the same purpose. From this it is an easy transition to the belief of the ancients that attaching itself thus to a vessel it might retard or even hold it back. Hence the name *Echeneis*, one that holds back a ship, and *Remora*, a holding back.

"There is scarcely a fish of the existence of which the ancients have been equally certain, and which has so much occupied their imagination—from a power thought to be inherent in the creature to counteract the strongest physical agencies,—as the *Echeneis* of the Greeks or the *Remora* of the Latins." †

* In gathering the material for this paper, I am under much obligation to Dr. C. R. Eastman of the American Museum of Natural History, New York City, and to Dr. H. M. Lydenberg, Reference Librarian of the New York Public Library. In his work for the American Museum on the great bibliography of fishes, Dr. Eastman ran across and kindly transmitted to me a large number of the references made use of in this paper. Dr. Lydenberg has, as heretofore, been a court of last resort for obscure and seemingly unintelligible references, every one of which he has, by reason of his large knowledge of matters bibliographical, been able to clear up. My best thanks are hereby rendered to him and to Dr. Eastman for their many kindnesses.

† Günther, 'On the History of Echeneis,' 1860.

The earliest references to this interesting fish are to be found in Aristotle's 'History of Animals.' A fish having such an extraordinary structure as the sucking-disk and having such unusual habits could hardly be expected to have escaped the keen observation of the Father of Natural History. Yet there is nothing in Aristotle's writings to indicate that he ever saw or at any rate that he ever examined the Echeneis with the care which he bestowed on the other animals of which he wrote. In Prof. D'Arcy W. Thompson's scholarly translation (Oxford, 1910), one may read (Book II. 14, 505 *b*, 19-22): "Of fishes whose habitat is in the vicinity of rocks there is a tiny one, which some call the Echeneis or 'ship-holder' Some people assert that it has feet, but this is not the case: it appears, however, to be furnished with feet from the fact that its fins resemble these organs." Again (Book V. 31, 557 *a*, 30-31): "In the seas between Cyrene and Egypt there is a fish that attends on the dolphin which is called the 'dolphin's louse.' This fish gets exceedingly fat from enjoying an abundance of food while the dolphin is out in pursuit of its prey."

In a footnote, Prof. Thompson identifies this fish as *Naucrates ductor*, a pilot-fish found in the Mediterranean. Now the term pilot-fish is applied rather indefinitely to a number of different fishes. The *Echeneis* or *Remora* is possibly the one best known, from its habit of sticking to dolphins, sharks, or any large fishes and swimming before their snouts. In our waters *Seriola zonata* and *S. carolinensis*, amber-fishes of the family Carangidæ, are found associated with sharks and are called pilot-fishes. They are likewise found around the rudders of vessels and hence are also called rudder-fishes. The *Naucrates ductor* of Prof. Thompson is a pilot-fish of the same family but of a different genus. It is found in warm waters throughout the world and has the same habits as the other pilot-fishes.

Thompson's footnote thus leads one away from the idea that the "dolphin's louse" is a sucking-fish, but it should be noted that this last reference comes in a section devoted to sucking insect parasites, lice, ticks, and fleas, and concludes with those crustaceans, "sea-lice" so called, which live parasitically on fishes. So from this internal evidence it seems probable that the fish referred to is an Echeneid, a sucking-fish, which attaches itself in a louse fashion to the dolphin as these fish are known to do *.

* In a short note published in 'Science' for September 1, 1916, the present writer endeavoured to show that Prof. Thompson's identification

In corroboration of the foregoing, Hasselquist may be quoted. In his 'Journey to Palestine' (1757) he notes that the Arabs at Alexandria called the sucking-fish (*Echeneis neucrates*) "*Chamel l Ferrhun*." Dr. Frank R. Blake of the Johns Hopkins University has been good enough to pass on this Arabic name. He writes that *Chamel* means louse, and that *ferrhun* is probably—or, at any rate, possibly—an erroneous transliteration for the Arabic *ferihun*, meaning agile or nimble. And that this meaning fits the actions of the fish, anyone knows who has ever tried to catch with a dip-net a shark-sucker from off its selachian host—it dodges as expertly as a squirrel around a tree. However, Dr. Blake says that there is an Ethiopic word *ferihun*, meaning terrible, and that Hasselquist's name may mean "the louse of the terrible one," and since this fish is found most frequently adhering to the shark, this translation seems the most logical one.

In further corroboration of the contention that the "dolphin's louse" is the *Echeneis*, another eastern traveller, Forskäl (1775), may also be quoted. At Djidda, a town on the eastern side of the Red Sea about midway between Suez and Aden, Forskäl collected *Echeneis neucrates*, and was at especial pains to note that the Arab fishermen there called it "Keide" or "Kaml el Kersh," which he translates "the louse of the shark"; while at Loheia, a town on the same side of the sea, but further towards the south-east, it is called "Keda." Dr. Blake has further obliged me by passing on these terms also. He finds that "Kaml el Kersh" means "the louse of the fish of prey," which fish Forskäl tells us in the context was a shark belonging to the genus *Carcharias*. *Keda*, he thinks, is probably a transliteration of the Arabic *Keide*, a fetter or band, hence "the attached one." Still other testimony may be adduced as to the even more recent use of this name. The German traveller Rüppell in his 'Fische des Rothen Meeres' (1835), published only some eighty years ago, says of *Echeneis*: "In the northern part of the Red Sea it is called *Delka* or else *Gammel el Kersh*,

of the dolphin's louse as *Naucrates ductor* is erroneous as is Aristotle's calling the little fish which lives among rocks *Echeneis*. The latter was identified as a goby and the "dolphin's louse" was shown to be a sucker-fish. Prof. Thompson on receiving this short paper very kindly wrote me that, while there might be still some uncertainty about the rock-dweller, he agreed as to the identity of the "dolphin's louse." And now it seems well to incorporate this note in these introductory paragraphs and to add certain other data which have come to hand since the above article was published.

in the southern part *Kied*." The latter names are, of course, variations of those noted above. Dr. Blake has not been able to throw any light on the word *Delka*.

From all this we see that, in the near East where changes take place slowly, *Echeneis* was still called "louse" some two thousand years after Aristotle. While to-day in our own waters, as well as in most tropical seas, there is a certain small *Echeneid* fish which Gill (1862) has named *Phthierichthys lineatus*, the striped louse-fish.

To return now to Prof. Thompson's "tiny fish whose habitat is in the vicinity of rocks." It seems to me that this fish cannot possibly be an *Echeneis*. The *Echeneis* is not a "tiny" fish, since the adult forms generally range in length from ten inches to three feet; likewise, so far as is known to naturalists, it does not dwell among rocks. In fish literature of the medieval and renaissance times, however, we do frequently run across references to *Echeneis* as a dweller among rocks, but I take these accounts to be merely echoes of Aristotle, since they are in other respects mere copies of preceding writers. Furthermore, this fish is said to have feet or, at any rate, fins resembling such organs. To the present writer there is no doubt that the fish here referred to is a goby, for gobies are small fish, are found in or near rocks, and have their forwardly-placed pelvic fins transformed into hand-like or sucker-like prehensile organs*.

THE MYTH OF THE SHIP-HOLDER.

It will be remembered that Aristotle (384-322 B.C.) calls our fish *Echeneis*, ship-holder, but that he nowhere refers to the miraculous power alluded to by other but later writers. So it is doubtful whether he knew of these alleged powers, *but if that be true why should he have named it ship-holder?* His words are "which some call the *Echeneis* or 'ship-holder,'" and he is evidently quoting some previous writer, or giving the name in common or everyday use. One thing is clear, *i. e.* he is *not* the originator of the term, nor is it very evident that he knew the fish by personal observation.

Before bringing to the attention of the reader the various stories ascribing miraculous powers to our fishes,

* Since writing the above I have found that Lowe, so long ago as 1843, expressed the belief that Aristotle's *Echeneis* was a blenny or a goby or a *Chironectes* and that the dolphin's louse was an *Echeneis*. On both of these points Günther (1860, 1880) likewise is in agreement with the author of the 'History of the Fishes of Madeira.' Day (1880-84) also has briefly expressed his belief in this identification.

figures of the fishes themselves are presented. Pl. XV. of this paper shows *Leptecheneis naucrates* (fig. 2) and *Remora brachyptera* (fig. 3), which are commonly found in our Atlantic waters. The essential external differences between the fishes are readily seen from the figures. Fig. 1 shows the sucking-disk of the Remora. Consideration of the structures of these fishes is reserved for a later paper.

The first definite reference to the ship-retarding power of the Echeneis is in a poem on fishing, "Halieutica," by the Latin poet, Ovid (43 B.C.—17 or 18 A.D.). Verse 99 reads: "Parva Echeneis adest, mirum, mora puppibus ingens"; which may be translated, "The small Echeneis is present, wonderful to say, a great hindrance to ships."

Pliny the Elder (23–79 A.D.) twice refers to the Echeneis. In Book IX. Chapter 41 of his 'History of Animals' he says: "It is believed that when it (Echeneis) has attached itself to the keel of a ship its progress is impeded, and that it is from this circumstance that it takes its name." This (together with other data extraneous to our subject) is taken from Aristotle. Then Pliny quotes one Mucianus (about whom nothing has been obtained) that a murex, a kind of gasteropod mollusk, has a similar ship-retarding power, and gives from this writer an alleged instance of a ship being held by it. Pliny in the same chapter quotes one Trebius Niger that the fish is about one foot in length and that it can retard ships. I have been unable to find out anything about this writer; this reference, like the one to Mucianus, is entirely obscure*.

In Book XXXII. Chapter 1, Pliny gives what is the first detailed account of the ship-holding power possessed by the Echeneis, and it seems well to quote him *in extenso* as given in Bostock and Riley's translation (1857).

"And yet all these forces [winds, tides, &c.] a single fish, and that of a very diminutive size . . . the fish known as the 'Echeneis' . . . possesses the power of counteracting A fish bridles the impetuous violence

* Pliny also gives two other uses of the Echeneis, which though outside the scope of this paper, are of enough interest to appear in a footnote. The first (which he seems to have had from the Greeks) is its use in love philters, and for the purpose of delaying judgments and legal proceedings; all of which he justly says are evil properties, compensated for, however, by its use to stay the flow of blood in pregnancy and for the preservation of the foetus *in utero*. The second use, quoted from Trebius Niger, is that when preserved in salt it is able to draw up gold from the bottom of the deepest well. These fictions are gravely repeated by many writers down to the middle of the seventeenth century . . . at least as late as the time of Rabelais (1553).

of the deep, and subdues the frantic rage of the universe—and all this by no effort of its own, no act of resistance on its part, no act at all, in fact, but that of adhering to the bark

“At the battle of Actium, it is said, a fish of this kind stopped the praetorian ship of Antonius in its course, at the moment he was hastening from ship to ship to encourage and exhort his men, and so compelled him to leave it and go aboard another. Hence it was, that the fleet of Caesar gained the advantage in the onset, and charged with redoubled impetuosity. In our own time too, one of these fish arrested the ship of the Emperor Caius (Caligula) in its course when he was returning from Astura to Antium: and thus, as the result proved, did an insignificant fish give presage of great events; for no sooner had the emperor returned to Rome than he was pierced by the weapons of his own soldiers. Nor did this sudden stoppage of the ship long remain a mystery; the cause being perceived upon finding that, out of the whole fleet, the emperor’s five-banked galley was the only one that was making no way. The moment this was discovered some of the sailors plunged into the sea, and on making a search about the ship’s sides, they found an *Echeneis* adhering to the rudder. Upon its being shown to the emperor, he strongly expressed his indignation that such an obstacle as this should have impeded his progress, and have rendered powerless the hearty endeavours of some four hundred men. One thing too, it is well known, more particularly surprised him, how it was possible that the fish, while adhering to the ship, should arrest its progress, and yet have no such power when brought on board”*.

This full and circumstantial account by Pliny is of great value, and the more so since everything leads one to believe in Pliny’s full credence in the wonderful power of the ship-stayer. In the paragraph following the above, our old Roman naturalist thus refers to its Latin name: “Some of our own authors have given this fish the Latin name of ‘*mora*’ [delay],” another reading gives “*remora*.”

The next of the ancients to write of our fish is the famous historian, Plutarch (46 A.D.). In his ‘*Symposiacs*,’ Book II.

* Bostock and Riley say in a footnote, “And well might it surprise him. If there was any foundation at all for the story, there can be little doubt that a trick was played for the purpose of imposing on Caligula’s superstitious credulity and the rowers as well as the diving sailors were privy to it.” Later it will be shown how entirely erroneous is this conjectural explanation of Pliny’s translators.

question 7, he says: "Chaeremonianus the Thrallian, when we were at a very noble fish dinner, pointing to a little, long, sharp-headed fish, said the Echeneis (ship-stopper) was like that, for he had often seen it as he sailed in the Sicilian sea, and wondered at its strange force; for it stopped the ship when under full sail, till one of the seamen perceived it sticking to the outside of the ship and took it off" But there was incredulity even in that day for Plutarch adds, "Some laughed at Chaeremonianus for believing such an incredible and unlikely story." Then Plutarch offers for this phenomenon an explanation of his own which will be given later.

Next we come to Oppian, who flourished late in 200 A.D. In his poem *Halieutica*—"On the Nature of Fishes and the Fishing of the Ancients"—as translated by John Jones, there are some 38 lines in which in very poetical and effusive fashion the action of the "sucking-fish" is described. In short, he tells how the fish clings to the keel of the swift ship and retards it, though the wind causes the sails to belly out. He seems, however, to have confused with the Echeneis the lamprey eel which has a round suctorial mouth.

The last of the ancients to catalogue the myth of the ship-detainer was Aelian, a Roman author contemporary with Oppian in the latter part of the third century A.D. In his '*De Natura Animalium*,' Book I. Chapter 36, he refers to "that fish which all men call remora because it holds back and delays ships." And, again, in Book III. Chapter 17, he tells us in very interesting fashion that: "Echeneis is a pelagic fish, black in appearance, equal in length to an average-sized eel, and named for the thing it does. For adhering with its teeth to the extreme stern of a ship driven by a following wind and full sails, just as an unmastered and unbridled horse is held in with a strong rein, so the fish overcomes the most violent onset of the winds and holds the ship as if tied fast to her wharf. In vain the middle sails belly out, in vain the winds rush forth, it holds steady the thing to which it adheres. The sailors know this indeed for the cause of this matter. Hence the name given to this fish, which, because of their experience with it, they call Echeneida (Remora)."

We next hear of the ship-holder in the writings of the early Christian Fathers, and I am able, thanks to the kind help of Dr. Eastman, to quote herein from two. The first of these seems to have been Saint Basil, sometimes called the Great, bishop of Caesarea in Cappadocia. In his

Hexameron*, Homily VII. paragraph 56, he writes: "If now you hear say that the greatest vessels sailing with full sails are easily stopped by a very small fish, by the Remora, and so forcibly that the ship remains motionless for a long time, as if it had taken root in the middle of the sea, do you not see in this little creature a like proof of the power of the creator?"

St. Ambrose (340-397) in his 'Hexameron,' the first edition of which bears the imprint Basileæ, 1566, describes Echinus (probably a misspelling of Echeneis) as a foreteller of storms. "At the approach of a tempest the fish lays hold of a rock and sticks fast to it until calm weather returns. The sailors, noting this, govern themselves accordingly." This is probably an echo of Aristotle's little fish found among rocks, and seems to be the first of a long succession of similar stories, ascribing to this fish weather-forecasting powers. St. Ambrose, however, does not seem to give the ship-holding story.

Jorath, who was probably an Oriental Christian of the twelfth century, speaks of a fish called Achandes which sticks fast to ships in the sea, thus making them to stand stock still †.

About the year 1250, Bartholomew Anglicus wrote his encyclopedic work 'De Proprietatibus Rebus,' which was translated by John Trevisa in 1397, and printed at Winchester in 1491. The following is his interesting account of the ship-holder, for which also I am indebted to the kindness of Dr. Eastman:—

"Enchirius is a little fish unneth [only] half a foot long; for though he be full little of body, nathless he is most of virtue. For he cleaveth to the ship, and holdeth it still steadfastly in the sea, as though the ship were on ground therein. Tho' winds blow, and waves rise strongly, and wood [violent] storms, that ship may not move nother [neither] pass. And that fish holdeth not still the ship by no craft but only by cleaving to the ship."

In 1475, Johann von Cuba (or Cube) published at Metz his 'Hortus Sanitatis.' In the edition of 1536 on page 78 of chapter 34 he discourses of Echeneis or Echinus. This,

* "Hexameron is the title of nine homilies delivered by St. Basil on the cosmogony of the opening chapters of Genesis Basil read the book of Genesis in the light of scientific knowledge of his day." He was born in 329 and died in his fiftieth year.

† For this reference I am indebted to Dr. Eastman, who ran across it on page 71 of Von Cuba's 'Hortus Sanitatis,' to which reference will be made later.

he says, is a little foot and a half long fish which lays hold of ships and causes them to stand still as if rooted in the sea, being held by nothing save the little fish. His story adds nothing to what we already know, but he does one thing which is of great interest, he gives us a quaint figure, which so far as I have been able to find, is the first and only effort to illustrate the myth. It is reproduced as fig. 4 (Pl. XV.). And in this connection one is led to wonder why this story, so interesting to these old-time writers, was not also a favourite theme for illustrators, why it has come down to us with but one picture.

In the 'Annotationes' of Francisco Massari, published at Basiliæ in 1537, there are in chapter 35 some three or four pages of data on the Echeneis, but careful perusal shows that this is but a revamping of the ancients with not a single new legend added, so Massari may be passed without further comment.

In the year 1550 there was published at Lugduni 'Liber I. De Sympathia et Antipathia Rerum' by Hieronymous Frascatorius, on page 24 of which is the statement that, "Furthermore it seems to be beyond all doubt that Echeneis is that little fish which we call Remora, which causes to stand still in mid-ocean the ship moved by the force and impetus of the wind" *.

According to both Gesner and Aldrovandi, there is to be found an account of the ship-holding power of Echeneis in Adam Lonicer's 'Naturalis Historiæ Opus Novum in Quo Tractatur de Natura,' etc., Frankfurt, 1551. The only edition found in New York is the German translation, which appeared as 'Kreuterbuch' in 1560. Dr. Lydenberg kindly looked through the 1682 edition of this in the New York Public Library, but could not find any reference to Echeneis. I have not been able to locate another copy. However, in Gesner's 'Historia Animalium,' IV. (1558), and also in Aldrovandi, there is a considerable quotation from Lonicer with reference to Echeneis. Careful study of this, however, shows that no new data are given.

The account of Edward Wotton (1552) is but a rehash of Aristotle, Pliny, and the other Greek and Roman writers. His one statement worthy of repetition reads "Let the winds rush and the tempests rage, the Remora dominates the furor, overcomes these great forces, and compels the vessels to stand still, which no chain and anchor have been

* For a transcript of Frascatorius I am indebted to the courtesy of Mr. Charles Perry Fisher, Librarian of the College of Physicians, Philadelphia.

made heavy enough to do." This, however, seems to be taken from Pliny.

In the sayings of Pantagruel, Rabelais (1553), in Book IV. Chapter 62, has the following:—" . . . an Echeneis or Remora, a silly, weakly fish, in spite of all the winds that blow from the thirty-two points of the compass, will in the midst of a hurricane make you the biggest first-rate remain stock still, as if she were becalmed, or the blustering tribe had blown their last." And again, in Book V. Chapter 26: " . . . there (in the country of Satin) I saw a Remora, a little fish called by the Greeks Echeneis, near a big ship which was motionless although under full sail, on the high sea."

We now come to Rondelet (1558), who attempts to show that the retardation of ships might have been effected by the Echeneis of Pliny, the great shell-fish of Mucian, or the eel of Oppian. Indeed, he asseverates (page 313) that he has known a lamprey to thus hold back a boat: ". . . it [Oppian's eel] stops it and holds it [a boat] back; a thing which corresponds to our lamprey, and which I have known through experience, for if it puts its mouth against a boat it stops it, and I have seen it thus." Then he adds, "There is no need to marvel that various fishes are called by different authors by the same name, nor that the same fish be called by many and divers names, for that often happens." For the rest, Rondelet quotes and comments on the accounts of Pliny and others on the true Echeneis (pp. 334-5), but adds nothing of himself. More might be expected of this great ichthyologist; but it seems that he never saw the fish (he gives no figure of it) and knew nothing of it at first-hand.

Conrad Gesner was the greatest of the encyclopedic writers of natural history, and his '*Historia Animalium*,' Books I.-III., was published Basel, 1551-1558*. In Book III. he discourses at considerable length "Concerning Echeneis or Remora," but there is nothing in his writings to indicate that he ever saw the fish. He adds no new data; but this section of his book is of value because in it he quotes a large number of the writers previously cited in this paper. However, even here his value to the student of ichthyological archaeology is crippled by the fact

* It will be noted that the works cited of both Gesner and Rondelet are dated 1558, and yet Gesner quotes Rondelet at considerable length. However, the apparent discrepancy disappears when it is remembered that Rondelet's '*L'Histoire Entière des Poissons*' is but a translation into his native French of his original work first published in Latin in 1554.

that he quotes his predecessors by name only, rarely by book or chapter. He adds nothing to our knowledge of the Myth.

Gesner, however, is the first writer since the ancients to attempt a description of Echeneis. This description, which is found in the last paragraph of his section on the Echeneis, is evidently that of a goby, and is quoted here that the reader may judge for himself, and not be led into the error of crediting Gesner with the first description.

"There is a little fish found in the ocean at Emda in Frisia (so a certain friend has related to me) four digits long, of very slimy skin, without scales, having a head large in proportion to its body, eyes small, the rest of the body cone-shaped. Under its chin it had the form of a sucker by which it probably adheres to rocks, for when he pressed this cavity with his finger (so my friend narrated it) it adhered to it so that it could be carried about."

In Chapter XXXVII. of Liber X. of his '*Operum*,' published at Lugduni in 1564, Jerome Cardan writes of the action of the Remora as if it were a settled fact, but adds nothing of value to detain us here. He will be referred to later as offering an explanation of the ship-staying powers of the fish.

Departing from the beaten track of repeating what some previous writer had copied, the Dutchman, Jan Huygen van Linschoten, or, as his name is Latinized, Joannes Hugo Linscotanus (1596), gives the following interesting and detailed account of the ship-holding power of the Remora:—

"And because I am now in hand with the Fishes of India, I will here declare a short and true Historie of a Fish, although to some it may seeme incredible, but it standeth painted in the Viceroyes Pallace in India, and was set downe by true and credible witnesses that it was so, and therefore it standeth there for memorie of a wonderful thing; together with the names and surnames of the ship, Captaine, day, & yere when it was done, and as yet there are men living at this day, that were in the same shippe and adventure, for that it not long since, and it was thus. That a ship sayling from Mosambique into India, and they having faire weather, a good fore winde, as much as the Sayles might brave before the winde, for the space of fourteene dayes together, directing their course towards the Equinoctiall line, every day as they tooke the height of the Sunne, in stead of diminishing or lessening their degrees, according to the Winde and course they had and held, they found themselves still contrarie, and every day further backwards then they were, to the

great admiration and wondering of them all, and contrarie to all reason and man's understanding, so that they did not only wonder thereat, but were much abasht beeing steadfastly perswaded that they were bewitched, for they knew very well by experience that the streame or course of the water in these countries did not drive them back, nor withhold them contrarie to all Art of Navigation, whereupon they were all in great perplexity and feare, standing still and beholding each other, not once knowing the cause thereof.

"At ye last the chiefe Boteson, whom they call the masters mate, looking by chance overbord towards the beakhead of the ship, he espied a great broad taile of a Fish that had winded itselfe as it were about the beakehead, the body thereof beeing under the keele, and the heade under the Ruther, swimming in that manner, and drawing the shippe with her against the wind and their right course: whereby presently they knewe the cause of their so going backwards: so that having at last stricken long with staves and other weapons uppon the fishes taile, in the ende they stroke it off, and thereby the fish left the ship, after it had layne 14 dayes under the same, drawing the ship with it against wind and weather: for which cause the Viceroy in Goa caused it to be painted in his pallace for a perpetuall memory, where I have often read it, with the day and the time, and the name of both shippe and Captaine, which I cannot well remember, although it bee no great matter" *.

Ferrante Imperato, a pharmacist of Naples, having a taste for natural history, formed a collection of such objects, and made the description of these the basis of his book '*Historia Naturale*,' published at Venetia, 1599. In this he writes: "Although the Remora of the ancients has by many been described under the forms of different fishes, there is, however, no description that fits except the one proposed by us. It has on the upperpart of the head tentacles similar to the vibratile combs [cirri, literally ringlets] of the polyps by which it attaches itself to ships or the bodies of large whales and other fishes."

With the above description Imperato published a figure of

* Linschoten's book was first published in Dutch at Amsterdam in 1596, but was translated into English and published in London in 1598, while in the following year (1599) a Latin version appeared at Amsterdam. The above account is taken literally from the English edition. For photostats of it and of the original Dutch edition I am indebted to the kindness of Dr. Lydenberg, who not only sent these, but who had previously in a most skilful manner run down Linschoten from an exceedingly indefinite and obscure reference in Nieremberg to the "*Pro-Rex Joannes Hugo*."

Echeneis or Remora which, so far as I have been able to find, is the earliest portrayal of the sucking-fish. This is reproduced herein as fig. 5 (Pl. XVI.). It correctly shows the projecting lower jaw, the position and general make-up of the sucking-disk, and the position of all fins, especially the long dorsal and ventral ones. The tail is not good. It is probably a Remora, since there is no effort to portray the lateral stripe of Echeneis. The crudity of the figure is, of course, apparent, but it is the *first*, and it is a fair portrayal. The disk is clearly shown, and in the description its function is definitely indicated for the first time in history *.

We come now to another original story of the wonderful power of the Remora. It is quoted from Ekman (who will be referred to later), who says that it was told by Bartolomeo Crescentio Romano in his book '*Nautica Mediterranea*' published at Rome in 1607. This book I have not seen.

"... and I must tell you about another deed of the devil, because you must know in how many ways this enemy of mankind works against poor seamen.

"On a voyage from Gaeta to Napoli, the galley '*S. Lucia*,' when sailing before a fresh wind and being two miles from port, stopped quite immovable in spite of her sail being strained. The steersman examined the rudder to see whether there was some rope or net fastened to it, and as nothing was found, he commanded the oars to be got out and the galley slaves to be forced on with hard blows. But the galley did not move from the spot, and when she had been lying motionless for a quarter of a hour or more, the other galleys, which had sailed on, shortened sails, waiting. Then a man named Catelano told the captain . . . to have three monks removed from the deck of the galley, and averred that the galley would then immediately begin to move; and when the captain had them removed, the galley certainly did begin to speed like an arrow.

"Then all the men were about to throw these three poor fellows into the sea, saying that they were excommunicated; but the same man Catelano helped them saying, that this was a stratagem of the devil to the detriment of the monks; and he obtained permission that they should only be taken from the vessel.

"This occurrence would have caused scientific men to suppose that a very small fish, resisting the progress of the

* The above figure and description are taken from the 1599 edition of Imperato's book found in the library of the Academy of Natural Sciences of Philadelphia. For it I am indebted to the kindness of Dr. Edward J. Nolan, Librarian.

vessel, had got the better of the force of the sails and oars and made the vessel stop."

We next come to another great ichthyological encyclopedist of the Renaissance, Ulyssis Aldrovandi, whose huge folio, '*De Piscibus et de Cetis*,' was published in 1613 at Bononiæ. This author devotes to the Remora some five pages, which are taken chiefly from Gesner. He discourses at considerable length of the ship-holding power of the Remora, and quotes Aristotle, Pliny, Rondelet, and several others of the authors previously considered in the present paper. However, it seems probable that he never saw the fish—at any rate, a careful translation of his very difficult Latin nowhere reveals any definite statement that he had seen it. However, he does the one good thing of giving us a figure and description which adds materially to our knowledge. A photographic reproduction of his drawing is given here as fig. 6 (Pl. XVI). Note that it is labelled the "Remora of Imperato and the author." Aldrovandi expressly says "... my drawing corresponds with that one's," but his figure looks like an Echeneis, and his description below confirms this idea. He says:—

"The color of the whole body almost inclines to violet, its sides are glistening, the body is cut into two in the middle by a sub-green line, and its tail verges to blue. There are six fins to the body, three on the belly, two each in the region of the stomach and one at the anus. Likewise there is one on the back, and the tail ends in another Its mouth is not unlike a dog's except that the lower jaw projects beyond the upper jaw contrary to that which we see in the shark. I think that this is a truer figure [than Imperato's]"*.

This description seems to have been made from the fish rather than from the drawing, since the latter does not show the median line. It is to be regretted that Aldrovandi does not give us a definite statement on this point.

Aldrovandi, in his discussion of the Remora, gives this interesting incident:—"Within the memory of our parents, it is said that the ship of Franciscus Turonensis, the Cardinal, when he was once upon a time going from Gaul by maritime journey into Italy, according to the narrative of Peter Melara of Bologna, a very brave knight and at the

* For the scholarly translation of Aldrovandi, I am indebted to Mrs. S. P. Ravenel, and to Miss Julia Dameron, associate professor of Latin in the College. Miss Dameron has also been so kind as to help me with a number of the other Latin articles herein referred to.

same time a very learned man, was delayed by a very small fish in the midst of its course" *.

The reference made to this same incident by John Johnston, in his book 'A History of the Wonderful Things in Nature,' London, 1657, on page 301, is probably taken from Aldrovandi.

At Geneva, in 1614, Bartholomew Keckermann published his works, and in his 'Disputationes Physicæ' he discusses the ship-staying power of the Remora. He adds nothing to our knowledge of the myth, but does offer an interesting explanation, which will be considered later.

We next come to Rochefort, whose interesting and instructive book on the Antilles was published at Rotterdam in 1665, who says that certain fish bear the name Remora "because they adhere to vessels as if they wished to arrest them in their course." Note the clause "as if they wished." The old order is passing away, men are beginning to seek a rational explanation of the retardation of ships, and doubt is being cast on the efficacy of the Remora as the agent.

So more explicitly writes Du Tertre, whose valuable natural history of the Antilles was published but two years (1667) after Rochefort's work. In the course of his description of the Remora and explanation of its activity, he writes:—

"For myself I hesitate to submit my judgment to that which some authors assure us concerning the Remora, saying that it brings to a full stop a ship which sails before the wind with canvas stretched on a full sea. Since there is so great a quantity of Remoras around the Western Isles, one could scarcely find a ship that would not have several attached to her, yet nevertheless during the century or more that these islands have been frequented, it has never been noted that a single ship has been thus arrested by the Remoras. This has caused me to think that the two or three vessels, which have been said to have been arrested by the Remoras, have been detained by some miracle or charm, and since at the time some Remoras have been attached to them

* Being unable to do anything whatever with this reference, I referred it to Dr. Lydenberg, who very kindly went into the matter fully. He finds that there was a Peter Melara of Bologna who left certain MSS. which are or were to be found in the "Biblioteca dell' Instituto" of that city. He suggests that Aldrovandi had access to this particular MS. This conjecture is strengthened when one remembers that Aldrovandi lived, wrote, and published his book in Bologna. Note, further, that he prefaces his statement by saying "within the memory of our parents."

in their usual fashion, to these have been falsely attributed the cause of their detention."

It will be shown later how closely Du Tertre came to a true explanation, and it is to be regretted that in substituting one mythical explanation for another he narrowly missed the truth. Therein he was better churchman than naturalist.

Le Maire (1695) writes "Le Sucez [Echeneis] is so called because it attaches itself by sucking. It is in size about equal to a sole. When it attaches itself to the rudder, it retards the vessel, but does not stop it as the Remora is falsely said to do."

In the face of what has just been quoted there is now to be presented from one of the most remote corners of the world another and much later story of the Myth. Faber, in his 'Natural History of the Fishes of Iceland' (1829), gives the following circumstantial account:—

"In Jan Olsen's MS. it may be read [that]: 'In the year 1720, by chance it happened on the strand before Hunevand's-Harde (in Nordisland) with a boat which had been rowed out for the autumn fishery, that when the fishermen wished to return they could not move the boat, although they rowed with all their might. Then there was noticed behind on the rudder a short stumpy fish, blackish-gray in color, which moved itself a little and adhered so solidly to the boat that one could scarcely pull it loose with the hand. It left behind on the boat a mark of its body, and when it was pulled loose the boat went forward. The fishermen burned it on the shore whereby a great stench was produced. This animal appears to have been a Remora, and through this account the matter seems to be confirmed that there are really such living fish which can bring a ship to a standstill.'" Faber then concludes: "The exaggeration of the account being allowed for, it is not to be doubted this was a sucking fish."

There is now to be given the latest and most modern account of retardation by the Remora that has come to light. In 1778 there was published in London, "Translated under the author's inspection," the 'Travels in Dalmatia' of the Abbé Alberto Fortis. The locality, it should be noted in passing, is not very far removed from the countries Greece and Rome, in which the legend originated. In a letter to Signior Marsili, Professor of Botany in the University of Padua, Fortis writes:—"I will finish this letter by relating a fact, to which you may give that degree of faith which you think it merits. You have often read in ancient natu-

ralists, of wonderful things done by the Remora, or Echeneis and not without some surprise will have learnt Pliny's story, who after having told us, on the faith of another, how Anthony was retarded on his voyage by means of this fish, asserts positively, that a ship with Caligula on board and four hundred rowers, was actually stopped by one of these fishes, while the rest of the fleet went on at a great rate. When I read this, I contented myself to shrug my shoulders, without perplexing my brain to find out by what natural processes, or matter of fact, such an opinion could become so generally received, that a man of sense as Pliny certainly was, should affirm it in positive terms. But chance led me to the discovery. We were sailing in a small bark between Vruillia and Almissa with a fresh equal gale, in the afternoon. The mariners were all at rest, and the steersman only was awake, and attended alone in silence to the direction of the bark ; when, on a sudden, we heard him call aloud to one of his companions, ordering him to come and kill the Paklara. Our learned friend Signior Guilio Bajamonti was with me, and understanding what the man meant, desired him to show him the fish that he wanted killed, but the fish was gone. Having interrogated the steersman, who did not want sense, and was a fisherman by profession, why he had ordered the Paklara killed, and what harm it had done ; he answered, without hesitation, that the Paklara used to take hold of the rudder with his teeth, and retarded the course of the bark so sensibly, that not only he, but every man who sat at the helm felt it there without seeing it. He added, that many a time he himself had caught the Paklara in the act and had frequently killed and eat it. That it was often met with in the waters of Lissa. That in shape it resembled a conger eel, and in length did not usually exceed a foot and a half. That if I had a mind to see, and catch one of them I needed only to go in a fishing boat, in the warm season, between the islands of Lessina and Lissa, where he had never failed to meet with them every year. I will not desire you to believe everything my pilot said ; but confess that I should be very glad to see the Paklara when it had taken hold of the rudder of the bark under sail. The wonderful strength of the muscles of some little marine animals, such as the *Lepades*, that so obstinately resist any attempts to disengage them from their rocks, the stroke proceeding with such rapidity from the Torpedo, known at Venice by the name of *pesce tremolo* and in the sea of Dalmatia by that of Trnak ; the vigor shewn by the *Dentici* in their convulsive motions even when out of their own element, not to mention

the larger fish, such as, Tunny, Dolphins, etc., give me ground to suspect, that if all that the ancients wrote concerning the Remora be not just literally true, it is not altogether false. It certainly is a thing worthy of some reflection, that Pliny speaks so diffusely concerning this phenomenon, as a known fact that could not be called in question. The Greeks adopted the notion of this extravagant faculty, by superstitiously hanging the Remora about women with child, to prevent abortion. I am not, however, so ready to credit these extravagances or in the least persuaded of the wonderful retarding force of this little fish; and think it sufficient to believe that the force of the Paklara may be felt at the rudder of a small bark, without troubling myself further about the Remora.

"The Remora of the ancients, and the Paklara of our days, have this remarkable difference, that the first is almost always of the testaceous kind, and the second is of the genus Murena."

From this we see that the Abbé was half convinced of the correctness of the sailor's belief as to the power of the Paklara. However, he thinks this fish to be a lamprey eel, while the Remora of Pliny is in his opinion a shellfish. This is confirmed by a further reference on page 325, which reads as follows:—"Among the curious fishes found in those waters [of Lissa] the Paklara is the most remarkable: I did not see it, but the description given me by the fishermen, agrees with the Echeneis of Artedi, and Gouan, though, in my opinion, not with the Echeneis or Remora of the ancients."

Before going into an explanation of the Myth of the Ship-holder, it may be of interest to show that the term Remora has attained a place in literature. Among the Romans we find Lucilius saying "A certain voice sounding forth made for you a Remora in your progress." Again, Plautus says "Those things are distasteful which obstruct many undertakings and they make for a Remora both in public and private affairs." However, since the word Remora is a common Latin term for a delayer or retarder, we cannot be sure that its use above is a reference to the fish; more probably it is a use of the term in its original and ordinary sense.

Probably not such, however, is the use of the term by St. Basil (329-379). He affirms that "Life is a voyage and in our life's ways, countries, courts, towns, and rocks are remoras."

In English literature, however, more direct allusions are

to be found. Thus Spenser, in his 'Visions of the World's Vanity,' i. p. 108, writes:—

“ Looking far forth into the ocean wide,
A goodly ship, with banners bravely dight,
Through the main sea making her merrie flight.
All suddenly there clave unto her keel
A little fish that men call Remora,
Which stopt her course, and held her by the heel,
That wind nor tide could move her thence away.”

And Ben Jonson says ('Poetaster, III. 1') :—

“ I say a remora,
For it will stay a ship that's under sail.”

And again, in his Act III. Scene 1, he makes Horace say to Fuscus Aristius of Crispinus, a great bore, who had nearly talked him to death:—

“ ARISTIUS. What ails't thou man?
HORACE. 'Death, I am seized on here,
By a land remora: I cannot stir,
Nor move but as he pleases.”

Maundrell, in his 'Aleppo to Jerusalem' (p. 46) writes:—
“ We had his promise to stay for us, but the remoras and disappointments we met with in the Road had put us backward in our journey.”

And again, Jeremy-Taylor quaintly says:—“ A gentle answer is an excellent remora to the progresses of anger, whether in thyself or others.”

Before leaving this part of the subject, the following story may be added as of interest. In David Livingstone's 'Missionary Travels and Researches in South Africa' (New York, 1858), on page 556, in writing of the Barotse valley on the Leeba River, one of the headwaters of the Zambesi, he says:—“ The Barotse [people or tribe] believe that at certain parts of the river a tremendous monster lies hid and that it will catch a canoe, and hold it fast and motionless, in spite of the utmost exertions of the paddlers.”

In the Indian Ocean around Zanzibar the Remora abounds in great numbers, and is used, as I shall show in another paper, for the purpose of catching turtles by virtue of its propensity for clamping itself fast to any floating object. At first I was inclined to think that the Barotse myth was a

far distant echo of the Zanzibar stories ; but Livingstone shows very conclusively that the inhabitants of the upper Zambesi *in his day* had no communication whatever with the coast. Such communication may have existed at an earlier day, and at that time the story may have been brought inland, or it may have arisen spontaneously. At any rate, it is very curious and is worth repeating in this connection.

THE MYTH EXPLAINED.

First Explanation : Foul Bottoms.

In giving the explanations of the Myth of the Ship-holder, it seems best to take them up chronologically, for, as might be expected, even in ancient days there were men whose minds sought a rational explanation.

The first person who attempted to clear up this matter seems, so far as can be found, to have been Plutarch (46 A.D.). On page 277 his account of the statement of Chæremonianus the Thrallian has been given, and it will be recalled that the latter was laughed at for believing such an extraordinary thing. However, Plutarch, entering into the conversation, said :—

“Therefore as those things mentioned are but consequences to the effect, though proceeding from one and the same cause, so one and the same cause stops the ship, and joins the Echeneis to it ; for the ship continuing dry, not yet made heavy by the moisture soaking into the wood it is probably that it glides lightly, and as long as it is clean, easily cuts the waves ; but when it is thoroughly soaked, when weeds, ooze, and filth stick to its sides, the stroke of the ship is obtuse and weak ; and the water coming upon this clammy matter, doth not so easily part from it ; and this is the reason why they usually scrape the sides of their ships. Now it is likely that the Echeneis in this case, sticking upon the clammy matter, is not thought an accidental consequence to this cause, but the very cause itself.”

Now it must be conceded that this is a reasonable explanation, and we will find that until the middle of the sixteenth century it was repeated as explanatory of ship-retardation.

Gesner (1558) quotes Plutarch at length, insists on the retarding effect of mosses and algæ (“multa alga & musco innascete”), and plainly shows that he regards these (among which the Echeneis is found) as an efficient cause in the slowing up of the speed of ships rather than the action

of the fish itself, although nowhere he expresses a disbelief in this power of the Echeneis.

Lævinus Lemnius * (1559), in discoursing of "Sea-weed and Sea Fucus," apparently only amplifies Plutarch when he says :—

"But Mosse must be held to be a thing different from these: one kind whereof grows not only on the shores, but upon the sterns of the ships, when they come home from long voyages, to which not only Mosse and Sea-weeds, but shell-fish and a little fish called Echeneis stick so fast, that they will stop Ships, and hinder their courses, therefore our men use to rub them off with sharp brushes, and scrape them away with irons that are crooked for the purpose, that the ship being tallowed and careened well and smoothly may sail the faster."

Aldrovandi, Gesner's great successor and copier (1613), devotes several pages of his huge folio to "Occultane an Manifesta Vi Naves Remoretur," most of his data being taken from Gesner. He gives at length Plutarch's explanation of the retardation as due to growths of marine algæ among which the Echeneis clings, thus being "not the cause of the retardation of the ship but an accident of the effecting cause."

Aldrovandi is the last of those who allege the growth of sea-weeds as a cause of the retardation. It began to be seen that, while such marine growths would slow up a ship, they did not explain the remarkable instances of retardation in which the speed of the vessel was checked for a while but which was presently regained. However, another attempt had been made to explain these erratic movements of vessels, and this will now be given.

Second Explanation: The Adhering Remora acts as a Rudder.

This seems to have been first advanced by Rondelet (1558) in these words:—

"Pliny and others are greatly astonished that it is possible for this fish to have the power to stop a moving vessel propelled by sails and oars; but, as Aristotle says, one wonders at many things of which one does not understand the cause . . . which we will give concerning the effect of

* Lemnius's book 'De Occultis Naturæ Miraculis' was first published at Antwerp in 1559. The above quotation is from the English edition, 'Concerning the Secret Miracles of Nature,' Book III. Chapter 9, pp. 218-219, published at London, 1658.

this fish taken by itself in the place it requires. Because the rudder is small and placed at one end of the boat it is managed by one man who does not exert himself greatly. In the same way it is easy for that which moves one end to move the whole, for as the force and swiftness of those things which are thrown or moved finally ceases, so at the end of a continuous thing in motion the movement is weak and feeble, and because it is weak it is easily disturbed and overcome. As a boat, which is a continuous thing, goes very swiftly when driven by the winds, the first end called the prow goes more rapidly, and the rear end called the stern goes not so rapidly for in this latter place is the rudder which, moved here and there, makes the prow move easily also, for the reason above mentioned, and consequently the vessel as a whole moves. In this way, if a vessel is lightly driven straight ahead, and if the *Echeneis* or *Remora*, having put its mouth against the rudder, moves it here and there, it is necessary that this movement through the continuity of the vessel be communicated also to the prow and that it stop in its first course to waver in this direction or that according as the fish moves it; for it is a thing proved by reason, and certified by experience, that however little one of the ends is moved, the other also and indeed the whole of any continuous body is moved in the same way."

In this Rondelet seems to have taken from Aristotle's treatise on Mechanics the latter's explanation of how a rudder causes a ship to change her course, and to have adapted it as seen above to try to show how the *Echeneis* causes a ship to change her course and be delayed.

The above is a good translation of Rondelet's old and very difficult French *. In another place, speaking of Oppian's *Remora*, which he identifies as the lamprey eel, and which is said to stop and hold back vessels, Rondelet affirms that this is "a thing which corresponds to our lamprey and which I have known through experience, for if it puts its mouth against a boat it stops it, and I have seen it thus." Here for the first time we have an eye-witness account of the ship-retarding power of a fish. The lamprey has a round suctorial mouth by which it transports stones to make its "nest" at the breeding-season, and by which it fastens itself to fishes. That it should thus fasten on to a vessel is by no means improbable, nor is it improbable that by violent motions it could slow up the speed of a small boat.

The 'De Subtilitate Rerum, Liber X.' of Jerome Cardan

* For this translation I am indebted to Miss Hinda Hill, head of the Department of French in this College.

seems to have been first published in 1550 ; however, it was included in his complete works published in 1564 at Lugduni. On page 117 of this edition he has a column devoted to the Remora and its activities. He describes at some length and in bad Latin how the Remora by adhering to the rudder and waving its tail to right and left, turns the ship in first one and then the other direction, thus causing it to waver and lose speed. He compares its action to that of the steersman of a boat, who, using an oar over the stern, influences her course more than all the rowers who are pulling hard.

Gesner (1558) quotes Rondelet at length, but somewhat simplifies the explanation of the latter, saying that when the Echeneis affixes itself to the stern or rudder, and when it moves body or tail it causes the vessel to stand still, or, at any rate, to waver in its course, "just as when in a calm the helmsman turns the ship in her prosperous and swift course over to a more inexperienced steersman who is not able to hold the tiller straight," and hence the ship has a wavering movement and does not make good progress.

Imperato (1599), who, as previously noted, was the first to explain how the Remora fastens itself to vessels or fishes, says :—"It has on the upper part of the head tentacles, similar to the vibratile combs [cirri, literally ringlets] of the polyps, by which it attaches itself to ships or to the bodies of whales and other large fishes and retards their course and restrains them at will ; not otherwise than the rudder, while projecting but little from the vessel, has the power of directing its course."

The next writer to proffer the explanation we are discussing is Aldrovandi (1613). However, he starts by quoting Aristotle on the use of the rudder in changing the motion of a ship. He then advances the same arguments which we have found in Gesner and which the latter expanded from Rondelet. However, Aldrovandi argues at considerable length and somewhat ingeniously, but the gist of his argument is that the Remora sticking fast to the stern or rudder by moving its tail or body moves this continuous thing, the ship, causing it to hesitate or even pause in its course. It must be said, however, that Aldrovandi's Latin is so imperfect, and hence so hard to translate, that it is hard to say how much of this is Gesner and how much Aldrovandi.

With the rise of the Renaissance, and the freeing of men's minds from many old-time superstitions, it began to be seen that it was an absurd impossibility any longer to think that one small fish could retard, much less cause to come to a

standstill, a large vessel. And so we find Rochefort (1665) remarking (as noted heretofore) that Remoras "adhere to vessels as if they wished to arrest them in their course."

Du Tertre, who was a contemporary of Rochefort, and whose book was published but two years later (1667), had seen a number of Remoras attached to ships in the West Indies, but had never known of a vessel which had been brought to a standstill by them. So he preferred to think that such vessels "had been detained by some miracle or charm."

Third Explanation: Large Numbers of Adhering Remoras.

Dampier, whose 'Voyages' was published in 1697, tells us that he found great numbers of Remoras in the Caribbean Sea and the Gulf of Mexico, and goes on to say with regard to their retarding power:—

"Any knobs or inequalities at a Ships bottom are a great hindrance to the swiftness of its sailing; and 10 or 12 of these [Remoras] sticking to it, must needs retard it, as much in a manner as if its bottom were foul." And in this conclusion Catesby (1754) fully agrees.

Le Maire (1695) remarks that "Le Sucez," if it attaches itself to the rudder, may retard the vessel but cannot stop it, as the old legend falsely had it concerning the Remora. While Leguat (1721) emphatically says that "It is very certain that these fish attach themselves often to vessels in the water, and when the number is sufficiently great, one cannot doubt that they are an obstacle to the course of these floating edifices, since they prevent their easy movement over the waves."

John Barbot (1732) is also very emphatic on this point. Referring to the common notion that the Remora by sticking to a ship can retard it, he says, "... some part whereof might be possible, if a sloop or small vessel had a thousand or more sticking to its sides and stern, they being commonly, at full length, about 3 foot long or better, for then they might considerably retard the sailing of such a vessel; but it is ridiculous to say that they can have any power over great ships under full sail, as is pretended."

In close agreement with Barbot is the great French naturalist Lacépède (1829), who in turn is probably quoting from the naturalist Commerson, from whose manuscripts most of Lacépède's information with regard to foreign fishes seems to have been obtained. After discussing the various

myths concerning the "ship-holder," the French ichthyologist goes on to say :—

"In the midst of these ridiculous suppositions, one truth however stands out; that is that on the instant when the keel of the vessel has adhere to it, so to speak, a great number of echeneises, it would experience in moving through the water a resistance comparable to that which a great number of shelled animals [barnacles?] would make if attached equally on its surface, when it glides with less speed through a fluid which grating on the asperities brings it about that the vessel does not possess the same 'liveliness.' But one does not fail to think that the circumstances under which the echeneises would find themselves thus accumulated [in such numbers] against the timbers and exterior of a ship would be extremely rare in all latitudes."

On this matter Lowe, in his 'Fishes of Madeira' (1843), after reviewing many of the Greek and Roman legends, makes the following conservative statement :—

"... there is much doubtless of mere fiction or exaggerated fancy; yet, on the other hand, it would be rash altogether to deny the truth. Like most popular accounts or vulgar errors, they may probably be founded on some real circumstances, or natural occurrence, distorted by exaggeration into the wonderful. There would be nothing marvelous, that a Lamprey, of even ordinary size, fixed to the keel or rudder of a boat, suspended by one end and struggling in the water should, as related by Rondelet upon his own experience, greatly retard such vessel's progress, render its course unsteady, and baffle the exertions of the rowers.

"Again it is remarkable that the Dalmatians at this day, as Schneider in his note on Aelian, II. 17, mentions on the authority of the Abbé Fortis, possess the same idea regarding a fish they call Paklara, which the ancients held regarding their Echeneis or Remora. So strange a notion is not likely to have originated from communication with others amongst a wild and illiterate population; or, again, to have sprung up spontaneously and independently without some real ground. Without recourse, therefore, to the marvelous or extraordinary on the one hand, or to mere fiction on the other, it does not seem unreasonable to suppose that the accidental attachment to the rudder of a small sized vessel of some fish like Rondelet's Lamprey may have originated an impression, which has subsequently been generalized and transferred to other sucking-fishes, in themselves incapable of producing like effects."

The soundness, the reasonableness of the conclusions reached by the various writers in the immediately preceding pages will appeal to every reader, but it must be remarked that these are all conjectures, not facts observed and recorded by scientific men. However, just here I am fortunate in being able to give the following quotation from one of the most eminent ichthyologists of the present day, Mr. David G. Stead. In his 'Fishes of Australia' (1906), pages 190, 191, we read:—

"Now, though it would be altogether impossible and out of all reason to suppose that one individual [*Echeneis*] could exert sufficient power to delay or retard a vessel's progress, still an instance has actually come under my notice, in which a sailing-vessel was considerably delayed while in tropical seas through a shoal of 'Suckers' attaching themselves all round its sides and bottom."

Unfortunately, I have had no experience of my own as to the retarding powers of this fish, but in the summer of 1915 I carefully questioned (avoiding all leading queries) one of the most experienced fishermen at Key West, Fla. We had just caught a large shark, and were vainly attempting to hook its sucking-fish attendant, when I related the story of the ship-holder, cast some doubts on it, and asked Griffin what he thought of it. He replied about as follows:—"They sure will hold a boat. I have seen ten or twelve under a boat at one time. This was while king-fish fishing at Bahia Honda. The king-fish were in big schools and were followed by hundreds of sharks. The 'suckers' on the boat came from the sharks. My brother and me had boats just like each other in size and build, but his was a little better sailer than mine. The first day he beat me, both sailing before the wind, but the second day I beat him. He said, 'No wonder I am losing, too many "suckers" hanging on her bottom.' All the Key West fishermen know that 'suckers' will sure hold a boat."

This was corroborated from his own experience by my captain, an educated young Englishman from the Bahamas. And both men agreed that of two fishing-boats of equal size and speed, the one having behind it a "trolling squid" for mackerel will be retarded and will lose in a close race.

In order that the reader may get a clear idea of the "brake" which a good-sized sucking-fish may put on the movements of its host, figure 7 (Pl. XVI.) is introduced just here. This is from a photograph of a model in the United States National Museum of a shark with its adhering *Echeneis*. The fish is about half the size of the shark—say,

3 feet to the shark's 6. Argument is not needed to establish the idea of a "brake." The figure is from a note by R. I. Geare in 'Scientific American' for 1902. Mr. Geare remarks that the shark often becomes "emaciated from the strain of pulling these uninvited guests around." However, it should be stated that in the figure here given the *Echeneis* is much larger in proportion to the size of the shark, so far as my experience goes, than is the case ordinarily. *Echeneis* is known to attain a length of 3 feet. A *Remora* half that size would be extraordinarily large. On the other hand, however, mention should be made of the fact that, while these semi-parasites are small, not infrequently several may be found on one shark. On a shark taken at Tortugas I found three, while one at Key West was infested with four, the largest about 30 inches long.

Scattered throughout ancient and mediæval literature are a number of more or less isolated explanations of submarine cliffs, of magnetic rocks, and of supernatural and inexplicable forces which held vessels as if anchored. These are widely scattered and little emphasized, and it does not seem worth while to go into them. A fair example is that of Kecker-mann (1614), who alleges that the *Remora* sticking to the stern of the vessel pours out a very viscid and cold humour which causes the water around the rudder to be congealed, making the vessel to lose steerage. Again, Johnston (1657) notes that the lodestone has the power of attracting things, and thinks that the *Remora* has some such non-understandable power.

Fourth Explanation: "Dead-Water."

From the foregoing accounts no one can doubt that a school of *Remoras* attaching themselves to a small vessel can seriously arrest it in its course, but that they could noticeably retard a large sailing-vessel or a steamer is absurd. However, there is not lacking evidence from the days of Pliny to the present time that large sailing-craft and in our times even steamboats have been mysteriously checked in their courses and even stopped almost or quite still. These being facts, it is necessary to find an explanation for them. This is to be found in the "Dead-Water" of sailors.

The phenomenon of "Dead-Water," in which a sailing-vessel loses velocity and in a light wind may even come to a stop, and in which even a steamer may be retarded, has long been known to seamen. Probably the earliest notice of this is to be found in Chapter X. of the 'Agricola' of Tacitus, where,

in speaking of the geography of Britain, he says :—"Thule [Norway?] was also seen, previously hidden by snow and winter; but the sea is said to be *tough* and hard for the rowers and to be little stirred by winds."

Nansen, in his Norwegian North Polar Expedition (1893-1896), repeatedly noticed this phenomenon. On his return he turned over this problem to V. Walfrid Ekman for explanation. Ekman's paper may be found in the 'Scientific Results' of the expedition, volume v. (1904), and from it the following interesting data are taken.

In order to ascertain the prevalence of this phenomenon, Ekman published appeals for information in thirty-six foreign and in all available Scandinavian newspapers. From the former he received nine answers citing the appearance of "dead-water" in ten different localities, while from Scandinavian waters no less than thirty-two regions are reported to abound in this phenomenon. From this data Ekman concludes that "... From some reason or other it (dead-water) is comparatively seldom met with beyond Scandinavia or appears in a less decided manner than in the Norwegian Fjords."

Foreign reports give dead-water as occurring off Taimur Island on the coast of northern Silesia, also in Kara Sea and Bay in the same region, on the Murman coast of north-west Russia, as very "troublesome off the great river mouths of South America," while off the mouth of the Orinoco a ship had to anchor to prevent drifting out of her course. This phenomenon is reported from the Gulf of Mexico and it has been experienced off the Baffin Bay coast of Labrador, while the Saint Lawrence mouth is designated by one Norwegian captain as one of the worst regions in the world for dead-water. Two circumstantial accounts are cited for this phenomenon off the mouth of Fraser River and another near Vancouver Island, in which localities it bears the familiar name used by Ekman. There are two reports of its occurrence in the mouth of the Congo, one for the mouth of the Loire River, and two for the Garonne River and the basin of Arcachon near Bordeaux.

These last instances, however, are not of such pronounced dead-water as in the following report of its occurrence not merely in the Mediterranean but between the island of Cerigo and the southern part of Greece. This very circumstantial account is, because of its pertinence to the Myth, given *verbatim* :—

"On January 2, 1858, we were between Cape Matapan and Cerigo and sailed eastward for the Archipelago. The

wind was W.N.W., a gentle breeze and water quite smooth. We had all sails set and made about $3\frac{1}{2}$ knots. At 10 A.M., when we were about 12 naut. miles S.W. of Cerigo, the brig no longer answered her helm and began to go up northward to the wind. We worked the helm but to no avail. We backed the yards and shivered the braces and made all conceivable manœuvres, but the ship only turned a little and went back again. The little wind we had, seemed to be the same as before, and there were many ships in company both to port and starboard of us, which sailed away, whilst we were lying as if at anchor. Yet there was one sail about 3 miles to port of us in the same predicament.

"In this manner we lay for $1\frac{3}{4}$ hours, when the ship began to glide and fall to leeward a little. We then got the head sails filled and had the aftersails shivering, and without any command of the helm the vessel got down into its course. The most remarkable thing was, however, that when I stood afore, I saw a long stripe stretching from the bow far over the water on each side dividing the water into two parts. The water around the ship was light gray, but ahead of the stripe it was wholly dark. These stripes seemed by and by to move aft . . . of course it was the ship that began to glide slowly onward . . . and after 5 or 6 minutes when the stripes had passed along the ship and had left the stern and the rudder, then, at that same moment, the ship again answered her helm and made head-way. The wind was about the same—W.N.W. by W. a gentle breeze. We made 3 knots, but no more, in the afternoon.

"When we approached Cerigo, the ship was about to get into dead-water again, but by working the rudder to and fro, we steered again, and after that, we did not feel the dead-water any more.

"The ship, during its long voyage, had become very dirty and overgrown with barnacles of 10 or 15 cm. in length, which may have had some effect."

From Ekman's quotations from his correspondents as to the occurrence of dead-water around Scandinavia, the following short excerpts are taken. In perusing them the reader is asked to bear in mind the very words of the quotations concerning the actions of ships found in the first section of this paper.

The 'Fram' being in dead-water off Taimur Island
"It may therefore be supposed that the speed was reduced to about a fifth of what it would otherwise have been": and when steam was cut off at 100–150 metres from the buoy, the speed was so reduced that the engine had to be

started to reach it. "Sailing vessels may . . . be seen stuck fast in spite of a breeze brisk enough to keep the sails fully strained Sometimes it happened that one vessel gets into dead-water and another not, though it is impossible to discover any reason for this." ". . . . we already had good speed, when all at once the ship took dead-water . . . she stopped so quickly that it looked as if she had dropped anchor." The vessels being becalmed, "One of them was towed away without any difficulty, while the other, though of similar size, got into dead-water, and an extraordinary amount of work was required to get this vessel from the spot." Another ship in dead-water drifted back four miles with the current "against the direction of the steady fresh breeze, although they had all sails set." Another observer writes that in dead-water it ". . . feels as if something were fastened to the ship and holding it back." "In such cases, one or more vessels might suddenly lose their steering and remain on the spot, while others pass freely through the midst of them at a distance as short as two or three ships' length. After a while it was the turn of the other vessels to get into dead-water." "We scarcely glided along and were forced to have all sails set, until we were quite near our anchorage. Then the dead-water suddenly let go its hold. Believe me, they were both in a hurry, the ship and the pilot. Braces and falls ran a race together, and we only just got the anchor dropped without any misfortune." "The brig got into dead-water. . . . The speed was lost, and the ship was as if nailed to the spot." When the dead-water let go with the sails drawing, ". . . it all at once appeared as if the vessel had cut loose from a mooring aft." An 8-knot steamer in dead-water ". . . according to the pilot's own phrase, hardly moved from the spot."

Other descriptions might be quoted, but, save the one now to follow, these are the most typical. The one now to be given, with a sketch showing the appearance of the water around the vessel, is from the pen of Kommandor-kaptein Joh. Kroepelien of the Norwegian Navy. He writes that the ship with all sails set, heeling over rather stiffly before a fresh breeze ". . . . all of a sudden, lost her headway without any perceptible external cause, and the turning power of the rudder became nil.

"We then perceived that the ship had taken dead-water. From about amidships and outwards on both sides and to a considerable distance aft she was surrounded by a mass of dead-water, smooth as glass, as if the surface were covered with oil. The line between this smooth surface and the

water farther out, looked like boiling 'rips' and was quite distinct, the outer surface being strongly rippled by the breeze. The roar caused by the dead mass of water which, clinging to the ship, was dragged along through the water outside, was so loud that it might well have been deemed we were in the vicinity of a rapid. I do not remember the appearance of the wake, nor, I believe, was there anything remarkable about it. The rudder was of no use; we were forced to handle the ship by means of the sails and our two boats towing from the bow, and thus we proceeded at a speed of one or two knots.

"In this manner we went on for a couple of hours. All of a sudden, without any known cause, we were set free from the dead-water. The wind had been very steady the whole time, and we had constantly endeavored to keep the ship in the same course. After being freed from the dead-water the ship got headway, and after a while we logged 7 knots, going close to the wind."

Captain Kroepelien's sketch is reproduced herein as fig. 8 (Pl. XVII.). Concerning such an appearance as is here shown, Ekman writes: "As the boundary waves (to be described and explained later) follow the vessel, their wave crests and wave hollows remain in an invariable position relative to the vessel. If the wave motion gives to the water at a particular spot a velocity with the vessel, it would appear as though a bulk of water were being dragged along with her, although it is really always a new mass of water which follows the vessel for a short distance. It is exactly analogous to a boat sailing before the wind with just the same speed as the breaking waves at her side. In the case of dead-water, on the other hand, the illusion will be more complete, because the vessel moves at a slow velocity, and the waves causing the motion of the water are themselves not visible."

In perusing the foregoing accounts, the reader cannot have failed to be struck by the capriciousness of the phenomenon of dead-water, its sudden and seemingly inexplicable appearance, its equally sudden and mysterious disappearance. It may cause a ship gradually to lose speed, or suddenly to be stopped still as if "nailed," "moored," or "anchored" to the spot. The ship may gradually regain her speed or may suddenly speed away "as if a mooring had been cut." Again, a ship may fall into dead-water while a near neighbour but a few cable lengths away may sail on her course without "let or hindrance."

The instances just quoted, closely, almost precisely, parallel

the accounts from the old writers given in the first part of this paper, and there can be no doubt that their phenomena were *bona fide* occurrences of dead-water. One cannot wonder then that when a ship was thus checked and an Echeneis found, as it was not unlikely to be, sticking to rudder or hull, that the fish was deemed the cause of the checking of the speed of the vessel, and that the myth grew and became widespread.

Thus far we have been occupied with Ekman's accounts of dead-water, now let us consider his explanation of this strange phenomenon. After a study of some 42 accounts and descriptions, foreign and domestic, he generalizes as follows: ". . . . I conclude that dead-water may occur in every place where fresh water flows out over the sea, but that for some reason or other it is comparatively seldom met with beyond Scandanavia or appears in a less decided manner than in the Norwegian fjords. . . . Dead-water only appears near to coasts, in those places where a suitable layer of fresh or brackish water rests upon the heavier sea-water. A vessel, moving in such a place at slight or moderate speed, may happen to feel the influence of this phenomenon; it is then said that the vessel has 'taken dead-water,' or 'got into dead-water.' It is a very troublesome matter indeed. A sailing vessel in this plight generally refuses to answer her helm and becomes unmanageable; steamers, at times sailing vessels also, keep their steerage, but nevertheless the dead-water is a great hindrance, causing the ship to lose her speed almost entirely. The 'Fram,' for instance, so generally capable of making 4.5 knots along the Siberian coast when heavily loaded, had her speed reduced to about one knot in dead-water."

Dead-water then appears to be due to a layer of fresh or brackish water resting upon the heavier sea-water. The greater the difference between the densities of the two layers of water, the stronger of the dead-water. A vessel sailing into such an area loses "way," refuses to obey her helm, and becomes unmanageable; even steamers have difficulty in maintaining speed, slow ones being greatly checked and at times brought almost to a standstill, while sailing-vessels may be completely stopped. This appears to be due to the fact that ". . . the vessel when moving at slow speeds generated large waves in the salt-water fresh-water boundary, and the resistance of these speeds was anomalously increased. At higher speeds, however, the waves disappeared and the resistance was not affected by the fresh-water layer."

Ekman tried many experiments in a large glass tank con-

taining a heavy bottom layer of salt water coloured with India ink, having on top of it an uncoloured layer of lighter fresh water. Through this fresh-water layer he towed with a constant or steadily increasing force a small boat model, and studied and even photographed the boundary waves set up in the fresh-water salt-water boundary. He likewise worked out the numerical results in a long series of extended and complex mathematical equations, and as a result of his experiments and calculations he states that : "It is proved by the theoretical and experimental investigation above, that a vessel moving in such a place creates waves in the boundary between the two water layers, and, that on this account, very marked effects on the speed of the vessel will occur ; and it will be shown below that from the existence of such waves all essential effects and peculiarities of the dead-water phenomenon can be very simply explained it will, in addition, be shown that the resistance and speed reduction due to the wave generation is of just the proper order of magnitude to explain the effects of dead-water ; so that the correctness of the explanation may be regarded as completely substantiated" *.

Fig. 9 (Pl. XVII.) is copied from Ekman's photographs showing how the retarding boundary wave is created and how it affects the vessel. Of these photographs Ekman himself writes : "The most important point, which the photographs described above clearly show is that the waves largely increase in height when the velocity of the boat increased toward the critical velocity, but when this is passed, and the boat is free from dead-water, the waves disappear." In this connection it should be noted that in (Ekman's) figures A, B, C, the boat is in dead-water with boundary waves steadily increasing in size. In D, however, the velocity of the boat has increased beyond the critical velocity and the boundary waves have disappeared the boat is free from or without dead-water.

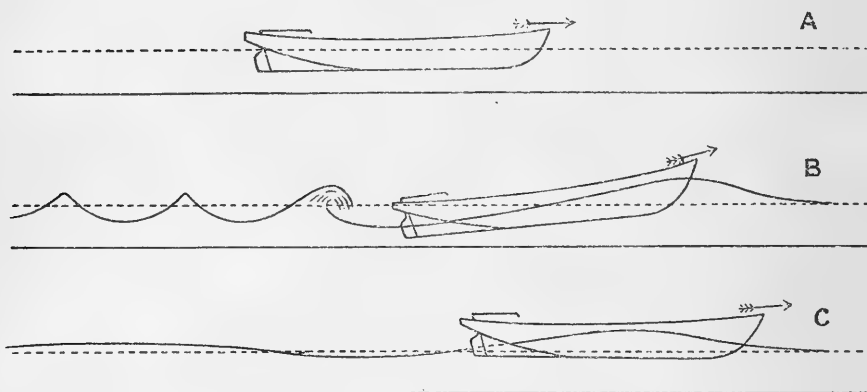
Fig. 10 (p. 304) is copied from Ekman from Scott-Russell (a distinguished English engineer of the middle of the last century) to show the effects of towing a boat in shallow water. Ekman uses it to explain the action of the boundary waves in dead-water. "At the lower velocity, the boat pushes a mass of water before her stem, and at her stern she provokes a wave-hollow ; her resistance is in consequence increased

* B. Helland-Hansen, in Sir John Murray and Dr. Johann Hjort's 'The Depths of the Sea' (1912), corroborated Ekman's conclusions, and, calling this wave a "boundary wave," says that it "may stop a ship so that it lies in dead-water hardly able to move at all."

just as if she constantly had to rise on an incline. She is then 'in dead-water.' At the higher velocity on the other hand, the boat moves on top of a low hillock of water, which she provokes, and she consequently moves on a nearly horizontal surface, and meets with little resistance.

As to the *modus operandi* by which a vessel in dead-water regains her speed, Ekman takes the case of a sailing-vessel which has taken dead-water because of a drop in the wind. "If the wind now recovers its initial strength, the only effect is that the vessel has her velocity increased a little , but she still lies in dead-water and consumes her energy of propulsion upon large boundary waves. Only if the wind freshens still more, so that the propelling force

Fig. 10.



Diagrams from Scott-Russell, after Ekman.

A, boat towed at low speed, no disturbance and no marked resistance; B, at the critical speed, boat tending constantly to rise on the "solitary wave" and meeting with great resistance; C, boat's speed exceeds the critical velocity, boat rides on top of solitary wave and meets with no resistance.

gets the better of the maximum resistance , is her velocity at once increased ; and the large boundary waves simultaneously disappear . . . the vessel has got free from the dead-water."

One other explanation and we have finished with Ekman. It has been noted repeatedly that vessels in dead-water refuse to obey the helm. If now one turns to Capt. Kroepelien's account and to Ekman's interpretation given on page 301, the explanation is apparent. Boat, rudder, and the surface

layer of fresh water are all moving forward at the same rate. Little, if any, of the rudder reaches down into the underlying salt water, and hence the vessel loses steerage.

There is little else to be said concerning Ekman's claim to have explained dead-water. He had done so in a wonderfully clear and explicit manner. In his paper he refers to the Myth of the Echeneis, and notes that the phenomenon of dead-water effectually clears it up. So it does, and another myth of the ancients is dissipated in thin air under the searching investigation of modern science.

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EXPLANATION OF THE PLATES.

PLATE XV.

- Fig. 1. Sucking-disk of Remora. After Jordan and Evermann, 1900.
 Fig. 2. *Leptecheneis naucrates*. After Jordan and Evermann, 1900.
 Fig. 3. *Remora brachyptera*. After Jordan and Evermann, 1900.
 Fig. 4. Echeneises adhering to a vessel. After von Cuba, 1536.

PLATE XVI.

- Fig. 5. Imperato's "Echenei, sev Remora," 1599, the earliest-known figure of scientific value.
 Fig. 6. Aldrovandi's Remora, 1613.
 Fig. 7. Sucking-fish attached to a shark. After Geare. Courtesy of 'Scientific American.'

PLATE XVII.

- Fig. 8. Kommandorkaptein Kroepelien's sketch of a vessel in "Dead-Water." After Ekman.
 Fig. 9. Photographs (from the side) of 'Fram' model in experimental tank; fresh water coloured light, salt water dark. A, B, and C in dead-water with the towing-force gradually increasing; D at high speed, without dead-water.

XXX.—*The Ungual Phalanges termed Mylodon australis by Krefft, Spelæan Animal vel Thylacoleo by Owen, and Thylacoleo by Lydekker.* By R. ETHERIDGE, JR., Director and Curator of the Australian Museum, Sydney, New South Wales.

[Plates XVIII.-XX.]

I. THE UNGUAL PHALANGES (*MYLODON AUSTRALIS*)
OF KREFFT.

When a name has crept into print and is in the course of time practically forgotten, or overlooked, as the case may be, it is only fair to the author thereof to resuscitate it, if found to be stable and of value. On the other hand, if established under a misconception, and found to be of no value, it were better relegated to the limbo of synonymy, or the society of abolished names.

There are several such names in the early annals of Australian Palæontology, and in the present paper I purpose dealing with the name *Mylodon australis*, Krefft, and the objects it represents.

Mr. Gerard Krefft, a former Curator of the Australian Museum, referred to his *M. australis* on, at least, four separate occasions. The first reference I have been able to light upon is contained in one of our Museum publications—'Guide to the Australian Fossil Remains exhibited by the Trustees of the Australian Museum, and arranged and named by Gerard Krefft,' &c.*, wherein we read :—

"Order E N D E N T A T A.

"Genus MYLODON ?

"*Myloodon ? australis*, Krefft.

"The presence of some animal, allied to the above extinct American genus, is indicated by a single terminal phalanx, or nail-bone, with its peculiar protecting bone, partly broken"†. This phalanx was obtained from the ossiferous deposit of the celebrated Wellington Caves, New South Wales.

The second reference appeared in Krefft's 'Australian Vertebrata—Fossil and Recent'‡, as follows :—

"E D E N T A T A.—Sloth Tribe.

"MYLODON.

"*Myloodon ? australis*,"

with similar remarks to those already quoted. This phalanx must have come into Krefft's possession between 1867 and 1870, because there is no mention made of it in the first edition of the 'Australian Vertebrata'§.

The third reference is of a controversial nature, and is contained in "A Cuvierian Principle in Palæontology tested by evidences of an Extinct Leonine Marsupial (*Thylacoleo carnifex*), by Professor Owen, &c. Reviewed by Gerard Krefft," &c.||. Confining our attention to that portion of

* Pp. 15, 8vo, Sydney, 1870.

† *Ibid.* p. 4.

‡ 'Industrial Progress of New South Wales,' pt. iii. 1871, p. 715.

§ Krefft, "Australian Vertebrata (Recent and Fossil), representing all the Genera known up to the present time. With Notes by Gerard Krefft." Cat. Nat. and Industrial Prods. N.S. Wales, sent to the Paris Universal Exhibition of 1867, by the New South Wales Commissioners (8vo. Sydney, 1867.—By Authority), pp. 91–110.

|| Krefft, Ann. & Mag. Nat. Hist. (4) x. 1872, pp. 169–182, pls. xi. & xii.

this paper strictly dealing with the matter under consideration, we find Mr. Krefft writing as follows:—"The claw to which I more particularly refer as being that of a 'megatheroid animal,' and which, with its next joint, is deposited in the Australian Museum . . . is what I stated it to be—"the ungual or terminal phalanx of a creature allied to *Mylodon*." The upper face of the sheath is naturally open; and the next joint is short and thick, like some of the phalanges of Professor Owen's *Mylodon*. . . . I only draw attention to the probability that there were in olden times, as at the present day, small Edentata as well as large ones; and as I first discovered the presence of fossil edentate Monotremes in this country, I may be allowed to say, with the evidence before me, that animals allied to the *Mylodon* will yet be found" *.

Before proceeding to consider Krefft's fourth reference it is necessary to ascertain what Sir Richard Owen said of these terminal phalanges. It appears photographs were sent to Owen by Krefft, but how many and whether or no with the latter's *Mylodon* name attached there is no evidence to show. "Amongst the fossils obtained by Professor (A. M.) Thomson and Mr. Krefft from the breccia-caves of Wellington Valley were several ungual phalanges, some of which, equalling or surpassing those of a lion, were compressed, the vertical exceeding the transverse diameter, and being considerable in proportion to the length: these phalanges are curved and pointed, but the point is more or less blunted or broken, apparently after interment. They support a claw, and in most there are traces more or less plainly discernible of a bony sheath † which bound or strengthened the attachment of the base of the claw."

Owen then described the bones separately and continued:—"From these specimens may be inferred a spelæan animal with subcompressed decurved pointed claws, equalling or exceeding those of the Lion or Tiger in size, but supported by phalanges resembling those of *Thylacinus*, *Dasyurus*, and the *Opossums* in being non-retractile, or wanting the characteristic low position of the joint in the sheathed claw-bones of placental Felines, but resembling these phalanges, rather than the non-contractile ones of the marsupials above mentioned, in the proportion of depth to length and breadth." And finally:—"No evidence of a Megatheroid or other Edentate animal has been found from any cave or

* Krefft; *ibid.* pp. 180-181.

† So far as I can gather only one exhibited this.

fossiliferous deposit in Australia. The shape of the ungual phalanges in Kangaroos and Wombats is known. The ungual phalanges ('Extinct Mammals,' pl. x. figs. 11-14) are too small for *Nototherium* and *Diprotodon*, if even one were to entertain the idea of those huge Marsupial Herbivora having had sheathed, compressed, decurved, pointed claws like those which the phalanges in question plainly bore. These phalanges are as much too large for the *Thylacinus* and *Sarcophilus* *. But there is no other associated Carnivore corresponding in size with that of the animal indicated by them, save the *Thylacoleo*."

Kreffft for the fourth time published his name and had figures prepared, the latter having a curious history. It appears that Owen, in 1867, proposed to the New South Wales Government "a careful and systematic exploration of the limestone caves of Wellington Valley," no doubt led thereto by his recollection of the discoveries made at Wellington by his old friend the Surveyor-General (Sir Thomas Livingstone Mitchell). This suggestion was adopted, and Krefft was placed in charge of the work; ultimately added to it was a similar exploration of the "Rivers of New South Wales." This exploration dawdled on until the early part of 1882, long after Krefft had ceased his connection therewith. A full account of all that took place during these fifteen years will be found in the N.S. Wales 'Votes and Proceedings' †, under the title, "Exploration of the Caves and Rivers of New South Wales (Minutes, Reports, Correspondence, Accounts)." The only portions of any scientific value are the reports of Messrs. Thomson and Krefft. In the latter's principal report, dated May 1870, the following appeared:—

"Order — ?

"*Mylodon? australis* (Kreffft).

"A distal or ungual phalanx of some unknown animal, resembling the same bone of a *Mylodon* (the distal phalanx of the pollex).

"The specimen referred to is quite unique, and proves the existence in Australia of a large sloth not unlike the

* Owen, Phil. Trans. 1871, pt. i. pp. 262-63, pl. xiii. figs. 11-14. It may be well to state at once, and definitely, that Owen's "ungual phalanges" comprised two entirely different types of nail-bones; this will be made abundantly clear in the sequel.

† Krefft, 'Votes and Proceedings,' v. 1882, pp. 551-602 (pls. 14 numbered and 17 unnumbered).

South American genus *Mylodon*; the size of the bone is about 1 inch and 2 lines in length. Another much smaller distal phalanx, also covered by a 'hood' is in the collection, but this belongs evidently to either a dog or cat-like creature" *.

Krefft gave three figures of the largest of these phalangeals in one of the numbered plates of the 'Caves and Rivers Report' (pl. 14, figs. 7-9). It appears that about 1870 he contemplated the publication of a work on 'Australian Fossil Mammals,' for which the seventeen numbered plates were prepared. But, as he explained elsewhere †, these plates "for want of funds were not published at the time," but in 1882 were appended to the Parliamentary "paper" referred to.

The MS. relating to these plates is preserved in the Mitchell Library, Sydney, and the explanation of figs. 7-9 reads as follows:—"Are distal phalanges or nail-bones of a very peculiar animal allied to the American genus *Mylodon*. It is impossible to say what kind of teeth the creature had judging from these two bones only. They probably resembled those of a Wombat."

One other reference will complete my knowledge of the history of *Mylodon* (?) *-australis*, Krefft.

In the 'Catalogue of the Fossil Mammalia in the British Museum,' pt. v. 1887, Mr. R. Lydekker, in the list of *Thylacoleo* remains, records the cast of an ungual phalangeal with the remark, "the bone was evidently covered by a horny claw, like that of *Phalangista*" ‡. Now the point is this, the Owen hooded phalangeal of *Thylacoleo*, is *not* the Lydekker phalangeal of *Thylacoleo*, but the unsheathed bones of both Owen and Krefft are the latter.

What Mr. Krefft's views of the affinity of his fossils may have been after September 1872, I have no precise means of knowing, but I do not suppose any alteration took place, as he appears to have been obsessed with the Edentate affinity of his fossils, and always maintained his own opinions with great pertinacity.

In the photographs supplied to Prof. Owen and published in the 'Philosophical Transactions,' 1871, Owen's figs. 11 and 12 on pl. xiii. are the equivalents of Krefft's pl. 14, figs. 7-9 of the 'Caves and Rivers Report,' in the first instance two, and in the second three views of one and the same

* Krefft, *loc. cit.* p. 558; both are identically the same.

† Krefft, *Ann. & Mag. Nat. Hist.* (4) x. 1872, p. 172.

‡ Lydekker, *loc. cit.* p. 195.

specimen, still in the Australian Museum. Sir Richard, unfortunately, interchanged the numbers of two of his illustrations between the letter-press descriptions (p. 262) and the figure numbers on his pl. xiii. thus :—

For pl. xiii., fig. 12 read fig. 13.

„ „ „ 13 „ „ 12.

In his 'Researches on the Fossil Remains of the Extinct Mammals of Australia,' &c. (1877) another interchange was made, thus :—

For pl. x. fig. 11 read pl. ix. fig. 12.

„ „ „ 12 „ „ 13.

There remains the smaller "distal phalanx" referred to by Krefft in the 'Caves and Rivers Report.' This specimen is 20 mm. long by 14 mm. in breadth, inclusive of the sheath or hood, which is complete proximally, but broken away towards the distal end of the bone. It is similar in shape to the nail-bone called *Myiodon* by Krefft, but with a greater degree of curvature, and less size. The articular surface, just as in that previously referred to, occupies nearly the whole of the proximal end, and is divided into two subarticular surfaces by a median longitudinal ridge for adaption to the convexities at the distal end of the penultimate phalanx. The tuberos process for the flexor tendon attachment is remarkably prominent and stout in comparison to the size of the entire phalanx ; on the plantar surface of this tuberosity are the two arterial foramina. Krefft considered this to belong "to either a dog or cat-like creature."

With this last exception such are the phalanges described by Krefft as *Myiodon australis*, a supposed Australian Edentate, and referred by Owen to his *Thylacoleo carnifex* by deduction. In considering the affinity of these bones, the following general conclusions may, I think, be fairly arrived at :—

1. The law of probabilities is decidedly adverse to Krefft's view. Had an Edentate existed in Australia in Post-Tertiary times, some more definite trace would have been met with ere this.
2. A right calcaneum, referred to this genus by Lydekker, is all we know of the feet of *Thylacoleo*, and this determination is problematical*.

* Lydekker, *loc. cit.* p. 195.

3. The reference of Krefft's *Mylodon* phalanges to *Thylacoleo* on the part of Owen was purely "conjectural" (to use his own expression), but at the same time a clever piece of deduction based on his view of the carnivorous habits of the "Marsupial Lion."
4. If we accept for the time being, the phalanges called *Mylodon? australis* as those of *Thylacoleo*, such acceptance will not in the least strengthen the views held either by Owen on the one hand, or Flower and his followers on the other, as to the gastronomical habits of *Thylacoleo*, hooded phalanges occurring amongst both herbivorous and carnivorous animals.
5. As possibly referable to *Thylacoleo* Owen figured two entirely distinct types of ungual phalanges.

We are now acquainted with the pedal bones of *Diprotodon* through the researches of Prof. E. C. Stirling, and it can be legitimately surmised that those of its second cousins *Nototherium* and *Euowenia* were similar. None of the Macropodidæ can put in a claim; amongst the flesh-eaters, *Sarcophilus* and *Thylacinus*, and the *Dasyures*, with the non-marsupial Warrigal, the osteological structure is too well known to require comment.

Finally, in all probability, although "conjectural" Owen's view of the nature of the hooded nail (eliminating those without a sheath) bones will in the long run prove to be correct; reduction of other genera by elimination supports it. If such be the case, then what is the claw referred to *Thylacoleo* by Lydekker? This will be investigated immediately.

The following is the synonymic bibliography of Krefft's ungual phalanges:—

- Mylodon? australis*, Krefft, Guide Austr. Foss. Remains, 1870, p. 4.
 „ *australis*, Krefft, Austr. Vert. Foss. & Recent (Industrial Progress of New South Wales), 1871, p. 715.
Spelæan Animal or Unguiculate Mammal, Owen (pars), Phil. Trans. 1871, pt. i. pp. 262, 263, pl. xiii. figs. 11–12 (*non* 13, 14).
Megatheroid Animal, Krefft, Ann. & Mag. Nat. Hist. (4) x. 1872, p. 180.
Spelæan Animal . . . Thylacoleo, Owen, Foss. Remains Extinct Mamm. Austr. i. 1877, pp. 182–183, ii. pl. ix. figs. 11–12.

Myiodon? australis, Krefft, N. S. Wales Votes & Proceedings, v. 1882, p. 558, 14th numbered pl., figs. 7-9.

II. THE UNGUAL PHALANX PROVISIONALLY CATALOGUED AS *THYLACOLEO* BY LYDEKKER.

Many years ago a plaster replica of another of Krefft's specimens *, described in MS. as the "nail-bone of the hind foot of a gigantic Phalanger, probably a small *Zygomaturus*, *Nototherium*, or *Diprotodon*" was forwarded to the Geological Department of the British Museum (Natural History). I surmised this might be No. M. 1526 † of the 'British Museum Catalogue of Fossil Mammals,' part v. (p. 195) catalogued by Lydekker as "cast of an ungual phalangeal" provisionally of *Thylacoleo*; by correspondence Dr. A. S. Woodward confirmed this. The original bone is preserved here and is slightly imperfect; it is from the Wellington Caves, and bears the number A. 13320 (Pl. XVIII. fig. 2). It is manifest, if the sheathed nail-bones ("*Myiodon*") are referable to *Thylacoleo*, following Owen, such an arched, laterally compressed and naked bone, one of those spoken of by Krefft as "large nail-bones . . . evidently those of a Phalanger" ‡, cannot. One of these § is probably the original of both Owen's illustrations of his non-sheathed *Thylacoleo* ungual phalangeal. Our collection contains five of these bones, four from the Wellington Caves ossiferous breccia (Pls. XVIII.-XIX. figs. 2-9), the fifth from Cope's Creek, probably from a thermal mud-spring deposit (Pl. XX. figs. 10-12). These vary much in size and degree of dorsal curvature, and for the convenience of description may be taken separately.

Type 1.—The phalanx in question || (Pl. XIX. figs. 8 & 9) is highly arched, compressed laterally, the dorsal edge thin, sharp (trenchant), the degree of curvature almost equal to the quadrant of a circle, the general appearance of the bone being decidedly hook-like. The proximal end is imperfect, the articular surface and the plantar tuberosity gone; it is 35 mm. wide, and in thickness 8 mm.

The second example never seen by Krefft or Owen (Pl. XX. figs. 10-12) is a more perfect specimen, one in

* Krefft, 'Caves and Rivers Report,' pl. 14 (numbered), fig. 12.

† Dr. A. S. Woodward informs me this should read 1536.

‡ Krefft, *loc. cit.* pl. 14. (numbered), figs. 11 and 12.

§ Krefft, *loc. cit.* MS. description of pl. 14. fig. 11.

|| Krefft, *loc. cit.* pl. 14. (numbered), fig. 2.

which the proximal articular surfaces, allowing for wear and tear, are perfect. The lateral surfaces (at the point of disruption in Pl. XIX. figs. 8 & 9) suddenly bulge outwards to form an expanded proximal end with a concave articular surface divided by a longitudinal central ridge, and below a very strong and comparatively large cushion for the attachment of the flexor tendon. Immediately above the centre of the tendon tuberosity on either side, are the foramina of the digital arteries. The surface of both specimens is pitted and roughened.

Length of complete bone 51 mm.; breadth 45 mm. approximately; thickness 13 mm.

Type 2.—The phalanges of the second type (Pls. XVIII.–XIX. figs. 2–7) differ from those of the first by a greater length in proportion to width, a much less arched dorsal edge, and a slightly less lateral compression, otherwise the same features characterize both. The following are the dimensions of the largest:—

Length 45 mm.; breadth 29 mm.; thickness 11 mm.

In the sheathed, or hooded terminals of Owen, although the nail-bone is compressed laterally (Pl. XVIII. fig. 1) the dorsal edge is only sharp or trenchant distally, the proximal end is truncate-flattened forming an elongately triangular surface. The articular surface for union with the distal end of the penultimate digit is highly concave, and much overhung above, as figured both by Owen and Krefft. The sheath is one with the core, or nail-bone, at the proximal end around the articular concavity, and along the plantar surface as far as it extends; the tuberosity is to some extent flattened. The arterial foramina pierce the sheath through the plantar surface of the tendon tuberosity, and then appear to enter the nail-bone as in the preceding type. Immediately below the dorsal truncate surface at the proximal end are two other arterial foramina.

Now, to what type of Marsupial do these ungual phalanges (Pls. XVIII.–XX. figs. 2–12) belong? It will be more satisfactory to consider Types 1 and 2 separately. Type 1 (Pls. XIX.–XX. figs. 8–12) is the “nail-bone of a gigantic Phalanger of Krefft,” but this form appears to have been quite unknown to Owen. In the Macropodidæ the nail-bones are elongate, non-trenchant, more or less oval in section, and very feebly arched, if at all. The nail-bones of the Peramelidæ are double, more or less circular, and non-trenchant. In the Phascolomyidæ, or Wombats, these terminals are again rounded above, roughly oval in section, and not hooked. The nail-bones of the Diprotodontidæ,

guided by Prof. E. C. Stirling's reconstruction of *Diprotodon*, resemble to some extent those of the Kangaroos, plano-convex, slightly curved, broad plantar surface, and the proximal concavities occupying the whole articular surface, instead of about two-thirds as in Types 1 and 2; moreover, the position of the foramina of the plantar artery branches is markedly different. What is true of the nail-bones of *Diprotodon* is possibly equally true of those of *Nototherium* and *Euowenia*.

There remain the Dasyuridæ and Phalangeridæ. In the first, taking the Tasmanian Wolf (*Thylacinus cynocephalus*, Harris) as an example, the nail-bones are long, more or less oval in section, rapidly decreasing in size from the proximal to the pointed distal end. The latter are more particularly accentuated in the Tasmanian Devil (*Sarcophilus ursinus*, Harris, Pl. XIX. fig. 14), in which the distal ends of these nail-cores are to all intents and purposes, acicular; hence, I dismiss the Dasyuridæ from consideration.

This reduces comparison to the Phalangeridæ, the family in which Krefft placed * these remains. The resemblance of the large complete specimen (Pl. XX. figs. 10-12) from Cope's Creek to similar bones of some members of this family is very striking. For the purpose of comparison I have selected two, the Great Flying Phalanger (*Petauroides volans*, Kerr) and the Koala, or "Native Bear" (*Phascolarctos cinereus*, Goldfuss) †. In the Flying Phalanger it is the 4th and 5th digits which terminate in nail-bones so remarkably like the Cope's Creek fossil (Pl. XX. figs. 10-12), but in the Koala the resemblance is not so strong (Pl. XIX. fig. 13), in consequence of the much greater length in proportion to width; this, however, only partially holds good for the pollices ‡. With these facts before me I can come to no other conclusion than that the subjects of Pls. XIX.-XX. figs. 8-12 are the terminal phalanges of an enormous Phalanger, following Krefft in this opinion, but in a more restricted sense than he employed the term.

We may now pass to the second type (Pls. XVIII.-XIX. figs. 2-7). The two specimens are Krefft's "large nail-bones

* Bearing in mind that Krefft included *Diprotodon*, &c., in this family.

† One fact in connection with the terminal phalanges, or nail-bones, of the Phalangers in general is very obvious, the stouter and stronger build of those of the fore feet, accompanied with a greater degree of curvature.

‡ One of the most noticeable features in Type 1 is the remarkable slab-sided, or straight-walled appearance.

... evidently those of Phalangers," and one (Pl. XVIII. fig. 5) is Owen's *Thylacoleo* "ungual phalangeal" (his fig. 13) and Lydekker's *Thylacoleo* "ungual phalangeal." By the same method of elimination as observed in the case of Type 1, I reduce consideration in this instance to the Phalangeridæ alone. There is no greater degree of variation between Types 1 and 2 than there is in the forms of the terminals of the same foot of many species of Phalangeridæ. I, therefore, again support Krefft's views of the affinity of these bones, but to what genus of the family the animal possessing them was most nearly allied only time can prove. For my own part I am rather in favour of a gigantic Koala.

The following table explains the relative identity of the various figures referred to:—

Krefft's figs. Austr. Foss. Remains.	Owen's figs. Phil. Trans. 1871 (1872).	Owen's figs. Extinct Mamm. of Australia.	Present figs.
Pl. 14, fig. 2.	.....	.....	Figs. 8 & 9.
" " 7.	.....	.....	.....
" " 8.	Pl. xiii. figs. 11 & 12.	Pl. ix. figs. 11 & 12.	Fig. 1.
" " 9.	.....	.....	.....
" " 11.	? Pl. xiii. figs. 13 & 14.	? Pl. ix. figs. 13 & 14.	? Figs. 5-7.
* " " 12.	.....	.....	Figs. 2-4.

In these notes I have sought to show that:—

1. Owen figured as the possible ungual phalanges of *Thylacoleo* two entirely distinct nail-bones—a "hooded" form, and an unhooded or unsheathed one; both cannot belong to the same kind of animal.

2. If the hooded bone be accepted for the time being as of *Thylacoleo*, then the bone catalogued as "cast of an ungual phalangeal" by Lydekker cannot possibly be so.

3. The non-sheathed terminals (Types 1 and 2) were never claimed by Krefft as appertaining either to his *Mylodon australis*, or to *Thylacoleo*.

4. *Thylacoleo* is regarded by the advocates of its herbivorous nature as a member of the Phalangeridæ. If it be so, then the phalanges of Types 1 and 2 may, perhaps, be those of it.

5. If the suggestion contained in the last paragraph should

* This is the original of the replica called by Lydekker *Thylacoleo* (A.M. 13320, B.M. 1526 (36)).

prove correct, it follows that the identity of the hooded bones (" *Mylodon australis* ") has yet to be discovered.

The suggestion of an extinct Koala may possibly be not so speculative as would at first sight appear when it is remembered that Mr. C. W. de Vis described* a portion of a fibula that he believed represented "a progenitor of the Koala." The further discovery of a premaxillary with its palatal process was held to strengthen this view. Said Mr. de Vis :—"The Koala, or Native Bear, is now one of the few types of Australian life which has not been recognized as a part of its ancient economy: yet it is one of which no one could be surprised to find an ancestral form among the past modifications of marsupial structure." He proposed to distinguish the former owner of this fibula by the name of *Koalemus ingens*. Portion of a shoulder-blade was referred to another extinct Phalanger (*Archizonurus securus*).

EXPLANATION OF THE PLATES.

- Fig.* 1. The original of Krefft's "ungual or terminal phalanx of a creature allied to *Mylodon*," with "its peculiar protecting bone partly broken." The original of Krefft's figs. 7 and 8, and Owen's 11 and 12. Wellington Caves. $\times 2$ diam.
- Fig.* 2. Ungual phalange "equalling or surpassing those of a Lion" (Owen). This is the original of Krefft's fig. 12, and Lydekker's Catalogue (M. 1526 (36)). Wellington Caves. $\times 2$ diam.
- Fig.* 3. Dorsal view of the bone, fig. 2. $\times 2$ diam.
- Fig.* 4. Plantar " " " " " " " "
- Fig.* 5. Another phalange similar to Fig. 2, but with the dorsal surface straight, or even a little concave. This is probably the original of Owen's figs. 13, 14. Wellington Caves. $\times 2$ diam.
- Fig.* 6. Dorsal view of fig. 5. $\times 2$ diam.
- Fig.* 7. Plantar " " " " " " " "
- Fig.* 8. Highly compressed ungual phalange with the proximal portion broken away. Original of Krefft's fig. 2. Wellington Caves. $\times 2$ diam.
- Fig.* 9. Dorsal view of fig. 8.
- Fig.* 10. Probably the almost perfect condition of an ungual phalange similar to that seen in fig. 8. Cope's Creek. $\times 2$ diam.
- Fig.* 11. Plantar view of fig. 10. $\times 2$ diam.
- Fig.* 12. Dorsal " " " " " " " "
- Fig.* 13. *Phascolarctos cinereus*, Goldfuss. Ungual phalanx of the right fore foot.
- Fig.* 14. *Sarcophilus ursinus*, Harris. Fourth ungual phalanx of right fore foot.

* De Vis, 'On the Phalangistidæ of the Post-Tertiary Period in Queensland,' Proc. R. Soc. Queensland, vi. pts. ii. & iii. p. 106.

XXXI.—Notes on Myriapoda.—XII.* *A Preliminary List for Derbyshire, with a Description of* *Brachychæteuma quartum*, *sp. n.*, and *Chordeumella scutellare bagnalli*, *var. n.* By HILDA K. BRADE-BIRKS, M.Sc., M.B., Ch.B., L.R.C.P., M.R.C.S., and the Rev. S. GRAHAM BRADE-BIRKS, M.Sc.

I. INTRODUCTION.

A short holiday in Derbyshire at the end of May and beginning of June 1918 gave us an opportunity to collect some centipedes and millipedes; and we feel that the results are of sufficient interest to warrant the publication of a preliminary list for the county, so arranged as to make mention of some of the work previously done by other collectors as well as to include our own 1918 records. Also, in September 1916, we made one excursion from the Staffordshire side to the Derbyshire–Staffordshire boundary near Beresford Hall; and, although there was some confusion in our minds as to the exact position of the boundary, we have incorporated some relevant results of that day's work in the present paper, recording the specimens taken there as from "near the R. Dove," because we are practically certain that these are truly Derbyshire occurrences. If we are in error about the county, the animals thus recorded were found close to the boundary of the shires, but on the Staffordshire side. Two species included under these circumstances in the present list, viz. *Polydesmus denticulatus* and *Scoliopterus acuminatus*, are not otherwise known to us from Derbyshire.

In several cases of material placed at our disposal by Mr. Standen, Mill Dale (Staffordshire) is included in our detailed records, because it is coupled as a collecting-ground with Dove Dale (Derbyshire); but in no case does such an occurrence stand alone as a county record.

In the Diplopoda and Chilopoda (with which this paper deals) we now know some thirty-one Derbyshire forms, and these are enumerated below:—

DIPLOPODA (= Millipedes).

1. *Glomeris marginata* (Villers).
2. *G. marginata perplexa*, Latzel.
3. *Iulus ligulifer*, Latzel & Verhoeff.

* A previous paper in this series—the fifth—appeared in this Journal, May 1917, ser. 8, vol. xix. p. 417.

4. *I. (Ophiulus) fallax*, Meinert.
5. *I. (Tachypodoiulus) albipes*, C. L. Koch.
6. *I. (Cyliandroiulus) silvarum*, Meinert.
7. *I. (Cyliandroiulus) britannicus*, Verhoeff.
8. *Schizophyllum sabulosum* (Linné).
9. *Trichoblanius guttulatus* (Bosc).
10. *Amsteinia fuscus* (Am Stein).
11. *Polydesmus complanatus* (Linné).
12. *P. coriaceus*, Porat.
13. *P. denticulatus*, C. L. Koch.
14. *Brachydesmus superus mosellanus*, Verhoeff.
15. *Ophiodesmus albonanus* (Latzel).
16. *Brachychæteuma quartum*, sp. n.
17. *Polymicrodon latzeli* (Verhoeff).
18. *Chordeumella scutellare bagnalli*, var. n.

CHILOPODA (=Centipedes).

19. *Lithobius forficatus* (Linné).
20. *L. variegatus*, Leach & Brölemann.
21. *L. melanops*, Newport.
22. *L. crassipes*, L. Koch.
23. *L. duboscqui*, Brölemann.
24. *Cryptops hortensis*, Leach.
25. *Geophilus carpophagus*, Leach.
26. *G. longicornis*, Leach.
27. *G. insculptus*, Attems.
28. *G. electricus* (Linné).
29. *Brachygeophilus truncorum* (Bergsøe & Meinert).
30. *Stigmatogaster subterraneus* (Leach).
31. *Scolioplanes acuminatus* (Leach).

The nomenclature in the two classes is difficult, especially the nomenclature of genera and subgenera, and, as there is difference of opinion amongst the leading authorities, it cannot be claimed that there is finality about all the names we have used in the foregoing list, nor by using these do we wish to infer that we have refused to consider the claims to priority of others. The fact is that we have not yet had the opportunity to consider all the complicated evidence involved in the question of some of these generic and subgeneric names.

In the detailed records in the second section of this paper other collectors' names are cited by initials, as follows:—

Mrs. Furness, *A. W. F.*; Mr. J. Wilfrid Jackson, *J. W. J.*; Mr. R. Standen, *R. S.*; Mr. C. R. Brown, *C. R. B.*; Mr. William Boulsover, *W. B.*

To each of these we offer our best thanks.

An asterisk indicates that the material forms a part of Mr. R. Standen's collection. When a record is followed by the letter G. and a number, the material is so registered at the Manchester Museum. The letter *J.* in brackets, after a

record, indicates that the identification is that of our friend Captain A. Randell Jackson, M.C., M.D., D.Sc., R.A.M.C.

In the section of the paper which deals with detailed records we have introduced a few diagnostic points which may be of value to other naturalists.

Geological Considerations, etc.

As far as our own 1918 collecting in the county is concerned, we worked in two areas, both of them predominantly limestone (Carboniferous Limestone) regions. The one was the Buxton neighbourhood, where Burbage was our centre, and where all our collecting was on the limestone, and the other was mostly in the limestone triangle roughly formed by Bakewell, Ashford, and Great Longstone; this area is indicated in the present paper as "Bakewell district," except where more explicit details are given—as, for example, in describing the occurrence of the new animals. One of us (S. G. B.-B.) accompanied the veteran local naturalist and antiquarian, Mr. William Boulsover, of Bakewell, on one excursion to Manners Wood, which stands out on a sandstone (Yoredale Series) ridge close to the town of Bakewell; the collecting done there is clearly indicated in the body of the records, but it may be noted that, in one short visit, *Lithobius variegatus* was taken there, although the writers did not meet with it in either of the limestone areas, one near by, on the occasion of their 1918 (May-June) collecting. The distribution of this species, which is the only centipede on our British list which is unknown outside the British Isles, is extremely interesting, and worthy of careful study, in which natural factors, including altitude, vegetation, and geological features should certainly be taken into account.

It may be added that the junction between the Carboniferous Limestone and the Yoredale Rocks in the neighbourhood of the Derbyshire-Staffordshire boundary, where we collected in September 1916, is near the county boundary in that area, the Derbyshire side being the border of an extensive limestone region.

Cave Hunting.

During our stay in the Bakewell district we made one excursion through Monsal Dale to Cressbrook with Mr. J. R. Widdowson to visit a cave in the limestone at Burynewick, but, after all, we were not successful in finding any myriapods there. Some good results are to be expected from

a proper exploration of our English caves, and this note may serve as a reminder to naturalists who visit caves for the purpose of studying other branches of science.

II. DETAILED RECORDS¹.

Class *DIPLOPODA*.

Subclass *CHILOGNATHA*.

Family *Glomeridæ*, Leach, 1814.

Subfamily *GLOMERINÆ*, Verhoeff, 1910.

Genus *GLOMERIS*, Latreille et Leach.

1. *G. marginata* (Villers, 1789).

10–20 mm.

This is the common pill-millipede. It is black dorsally, but the pleurotergites are edged with white.

*Cave Dale, *R. S.*, in a recent year (*J.*), *G.* 3143; *Castleton, *R. S.*, vi./13; *Dove Dale, *R. S.*, *J. W. J.*, *C. R. B.*, 25/v./16; near the R. Dove, ourselves, 1916; Bakewell district, ourselves, 1918; one example, Manners Wood, near Bakewell, *W. B. & S. G. B.-B.*, 6/vi./18.

In addition to the above examples we have examined specimens from Millers Dale which do not appear to be typical. In spirit-specimens the dorsal surface of the body exhibits a row of light spots on either side of the middle line, due to the fact that the lateral parts of each pleurotergite are marked by definite light oval areas. The dimensions are the same as those of the typical form. We think it inadvisable, however, to establish a new variety on the material at our disposal until, at any rate, we have made a detailed study of the English representatives of the genus.

Seven examples, Millers Dale, *R. S.*, 17/vi./17.

Types. 1302, Brade-Birks collection.

2. *G. marginata perplexa*, Latzel.

6.5 mm.

At present we think it advisable to treat this form as of subspecific rank. Mr. Bagnall says (1) of this animal, "I cannot think that it can be a form of *marginata*, and *connexa*

¹ The typical length of the species is given in each case as a guide to those interested in the group. Where the dimensions are not our own, we are indebted to various authors.

is unknown in our Islands ; a study of British examples may show it to be a distinct species."

We have not yet been able to make a careful study of the genus *Glomeris*, but we may add that the animal in question is smaller than *G. marginata marginata*, although it has the white edges of the pleurotergites as in that form. Its general body-colour is brown, and its dorsal surface is furnished with four longitudinal rows of light spots. Two rows are distinctly lateral, while two are close to the median line. These more median rows are formed by a pair of spots on each pleurotergite, which tend to coalesce anteriorly and form a V-shaped marking on each segment. These more median rows alone are continued on to the last segment. Professor Ribaut has recorded the animal (10) under the name of *G. connexa perplexa*, Latzel ; Dr. Verhoeff, on the other hand, records it (13) as *G. marginata perplexa*, Latzel, and adds a note of which the following is a rough translation :—"Recent investigations have shown me that *perplexa* and *marginata* belong to the same species, but not to *connexa* ; I shall reconsider this point more carefully in another paper." We are not familiar with any later note by Verhoeff on this subject.

*One specimen junior, Castleton, *R. S.*, vi./13.

Family **Iulidæ**, Leach (ex p.), 1814.

(Genus **IULUS** (s. l.), Brandt, 1833.)

Genus **IULUS**, Brandt.

3. *I. ligulifer*, Latzel and Verhoeff.

Syn. *I. scandinavicus*, Latzel.

15-35 mm.

Verhoeff (13) includes this species in the subgenus *Micro-podoiulus*.

The females of this species are very like those of *I. fallax*. The coxite of the second leg of the male, however, bears an oval expansion, which serves to characterize *I. ligulifer*.

1 ♂, 2 ♀, Buxton district, ourselves, 1918.

4. *I. (Ophiulus) fallax*, Meinert, 1868.

Syn. *I. longabo*, C. L. Koch, 1847.

♂ 18-32, ♀ 25-45 mm.

A fair-sized black julid, very like *I. ligulifer*, the females being practically indistinguishable from those of that species.

Both animals have an acute caudal process and smooth pronotites. In *I. fallax* the legs of the first pair, in the male, are sickle-shaped.

*1 ♀ (or *I. ligulifer*), Cave Dale, *R. S.*, in a recent year (*J.*), G. 3159; both sexes, Bakewell district, ourselves, 1918.

Genus TACHYPODOIULUS.

5. *T. albipes* (C. L. Koch).

Syn. ? *I. niger*, Leach.

I. transversosulcatus, Am Stein.

♂ 22-30, ♀ 25-35 mm.

This large black julid is easily distinguishable under the microscope by the presence of transverse striae on the pronotites, to which Am Stein's name for the species owes its origin. This animal is common in our islands.

* ♀, Kings Sterndale, near Buxton, *R. S.*, 18/viii./13 (*J.*), G. 3154; * ♂, ♀ ♀, in a collection from Dove and Mill Dales, *R. S.*, 21/iv./14 (*J.*); 1 ♂, near the R. Dove, ourselves, ix./16; Buxton & Bakewell districts, ourselves, 1918.

Genus CYLINDROIULUS, Verhoeff.

(1894 as a subgenus, 1899 as a genus).

Prof. Silvestri informs us, *in litt.*, that he considers that *Cylindroiulus* and *Diploiulus*, Berlese, 1886 (2) are synonymous, the latter having precedence. This conclusion, however, does not meet with the approval of all continental authorities.

6. *C. silvarum* (Meinert).

Syn. ? *I. punctatus*, Leach.

15-25 mm.

An animal commonly found between the bark and trunk of rotting logs. The caudal process is club-shaped.

* ♀, in a collection from Dove and Mill Dales, *R. S.*, 21/iv./14 (*J.*); 1 ♀, near the R. Dove, ourselves, ix./16; both sexes, Bakewell district, ourselves, 1918; several, including 1 ♂, Manners Wood, near Bakewell, *W. B. & S. G. B.-B.*, 6/vi./18.

7. *C. britannicus* (Verhoeff, 1891).

Syn. *I. frisioides*, Verhoeff, 1892.

I. luscus, Meinert, as used by Bagnall and by ? Jackson. On this point see Bagnall's note (1) and our own (3).

16-18 mm.

An interesting tailless julid. The only known English millipede with which this is likely to be confused is *C. frisius*, Verhoeff, from which it is distinguished by the form of the gonopods of the male. Upon dissection, we found that one male taken by us at Great Longstone, 1918, belongs to this species. This specimen in spirit was 12.5 mm. long. A female taken by one of us (*S. G. B.-B.*) at Burbage Hall, 27/v./18, is probably referable to this species.

Genus SCHIZOPHYLLUM.

8. *S. sabulosum* (Linné).

20-46 mm.

This is a large and handsome julid, marked with two bright yellow dorsal stripes running the whole length of the body.

*2 ♀ ♀, The Winnats, Castleton, *R. S.*, in a recent year (*J.*), G. 3164; numerous, Dove Dale, *R. S.*, *J. W. J.*, *C. R. B.*, 25/v./16; 1 ♂ junior, near the R. Dove, ourselves, ix./16; adults, Bakewell district, ourselves, 1918.

Family Protoiulidæ.

(Genus BLANIULUS (s. l.), Gervais, 1836.)

Genus TRICHOBLANIULUS, Verhoeff.

Syn. Verhoeff uses the subgeneric name *Typhloblaniulus* (13), which is used as generic by Ribaut (9).

9. *T. guttulatus* (Bosc).

Syn. ? *Iulus pulchellus*, Leach (nec C. L. Koch).

9-18 mm.

A common blind blaniulid, which is sometimes a pest in potato crops. It is a worm-like form.

Both sexes, Bakewell district, ourselves, 1918.

Genus AMSTEINIA, Verhoeff.

10. *A. fuscus* (Am Stein).

9-16 mm.

Males of this species are rare; the present record is, however, admissible, as the eyes prove a useful diagnostic character. The ocelli are arranged much the greater number in a long single row, the remainder in a small elongated triangle with its base against the central part of the row. The animal

is often associated with *Cylindroiulus silvarum*, and its usual habitat is between the bark and trunk of rotting logs.

Very few specimens (no adult ♂), Bakewell district, ourselves, 1918.

Family **Polydesmidae**, Leach (ex p.), 1814.

Genus **POLYDESMUS**, Latreille, 1802 & 1804.

11. *P. complanatus* (Linné).

13-28.5 mm.

This large flat-backed millipede is common in the British Isles. Its gonopods are distinctive. The genus has twenty body-segments.

*2 ♂♂, The Winnats, Castleton, *R. S.*, in a recent year (*J.*), G. 3149; *2 ♂♂ and juniors, Cave Dale, *R. S.*, in a recent year (*J.*), G. 3136; *♂♂♀♀, in a collection from Dove and Mill Dales, *R. S.*, 21/iv./14 (*J.*); ♂, near the R. Dove, ourselves, ix./16; Bakewell, ourselves, 4/vi./18; 1 ♂, Manners Wood, near Bakewell, *W. B. & S. G. B.-B.*, 6/vi./18; Bakewell district, ourselves, 1918.

12. *P. coriaceus*, Porat.

12.5 mm.

This species is smaller than *P. complanatus*, also the males have distinctive gonopods. A male from Great Longstone which we dissected for careful diagnosis was 12.5 mm. long.

Bakewell district, ourselves, 1918.

13. *P. denticulatus*, C. L. Koch, 1847.

10-16 mm.

Again the gonopods of the male are diagnostic. In this character we did not find the male recorded below quite typical. The slight difference, however, is probably no more than an individual peculiarity in the specimen in question. On the whole the condition of the gonopod is similar to that of the preparation given by Dr. Brölemann in figure 34 in the xviii. paper of the 'Biospeologica' series (7). In our example the secondary ramus is arched much as that is in the fig. 34 cited. To adopt the lettering used by Dr. Brölemann, its external appendix (*p*) is well developed, broad, slightly arched, and furnished with a well-marked sharp tooth (*p'*) near the base, as in figure 34 (*op. cit.*). The individual difference we have noted (*ante*) consists in the presence of a second small tooth on the internal face of the distal part of

the secondary ramus. The seminal ramus presents the usual features; the small tooth (*y*) of the external face is well-developed.

1 ♂ (and ? other material), near the R. Dove, ourselves, ix./16.

Genus *BRACHYDESMUS*, C. Heller, 1857.

Species *B. superus*, Latzel, 1884.

14. *B. superus mosellanus*, Verhoeff, 1891.

8.5–9 mm.

The genus to which this animal belongs has nineteen body-segments. The present variety, with typical gonopods in the male, seems to be the common English form. We have dissected specimens from both the localities mentioned below. In the garden of Beech House, Great Longstone, we met with large numbers of the animal.

Buxton and Bakewell districts, ourselves, 1918.

Genus *OPHIODESMUS*.

15. *O. albonanus* (Latzel).

Syn. *Paradesmus albonanus*, Latzel.

4.5 mm.

This minute square-backed millipede (our spirit-specimen is 4.5 mm. long) will probably prove to be not uncommon in Britain. Dr. Brölemann kindly confirmed the species by examining a drawing of the gonopod dissected from a specimen collected in another part of the country by our friend Mr. Bagnali, who was good enough to send it to us, correctly labelled. The example recorded below was adult, being furnished with the characteristic gonopods of the species. We suspect that the animal occurs in the garden of Ashford Vicarage, but we failed to obtain adult males there in spite of careful collecting.

1 ♂, in the garden of Mrs. Thornhill's home, Beech House, Great Longstone, ourselves, 1918.

Family *Brachychæteumidæ*, Verhoeff et Brade-Birks, 1911, 1918.

Genus *BRACHYCHÆTEUMA*, Verhoeff et Brade-Birks, 1911, 1918.

Syn. Owing to errors in Verhoeff's original description we established *Iacksoneuma*, 1917, to receive a new species *Brachychæteuma bradeæ* (Brölemann et Brade-Birks, 1917) (5). In the light of new material of the genotypical species, *Iacksoneuma* becomes a synonym of *Brachychæteuma*.

16. *B. quantum*, Brade-Birks (to be described later in the present paper).

♀ 7-8 mm.

While collecting on a slope by the side of the Ashford road, close to the town of Bakewell, one of us (*H. K. B.-B.*) came across a specimen of a square-backed millipede which we recognized in the field as belonging to the family *Brachychæteumidæ*. Although we searched carefully not only both of us on this, but also one of us on another occasion, we failed to collect another example. It became clear upon examination with the microscope that this specimen could not be referred to any of the three known species; a description is therefore given in another part of this paper.

1 ♀, near Bakewell, *H. K. B.-B.*, 29/v./18.

Family *Craspedosomidæ*, Verhoeff, 1909.

Subfamily *CRASPEDOSOMINÆ*, Verhoeff, 1909.

{Tribe *CRASPEDOSOMINI*, Verhoeff, 1909.

Genus *POLYMICRODON*, Verhoeff, 1897.

Subgenus *POLYMICRODON* (s. str.), Verhoeff, 1897.

17. *P. latzeli* (Verhoeff, 1891).

Syn. *Atractosoma latzeli*, Verhoeff, 1891.

? *Atractosoma polydesmoides*, Leach.

? *Atractosoma latzeli gallicum*, Verhoeff, 1895.

? *Craspedosoma latzeli gallicum*, Verhoeff, 1896.

? *Polymicrodon latzeli gallicum*, Verhoeff, 1897.

17-18 mm.

A flat-backed animal with thirty body-segments. We have little doubt that this species should be called *P. polydesmoides* (Leach), but until the type-specimens of Leach's animal are examined it seems unwise for us to make the alteration. The characteristic gonopods are figured by Verhoeff (12), and those of *P. latzeli gallicum*, which is perhaps a synonym, by Ribaut (11).

* ♂ ♂, Cave Dale, *R. S.*, in a recent year (*J.*), G. 3147. We also took specimens almost certainly referable to this species in the Bakewell district, 1918, but there were no adult males for definite diagnosis.

Family **Chordeumidæ**, Verhoeff, 1899.

Subfamily *MICROCHORDEUMINÆ*, Verhoeff, 1910.

Genus **CHORDEUMELLA**, Verhoeff.

Species *C. scutellare*, Ribaut, 1913.

18. *C. scutellare bagnalli*, Brade-Birks (to be described later in the present paper).

6.0 mm.

While collecting in the garden of Beech House, Great Longstone, one of us found a number of specimens of a small millipede of the genus *Chordeumella*. Upon microscopic examination it became evident that this creature cannot be referred to the only known British representative of the genus, *C. scutellare brölemanni*, Brade-Birks, although it falls into the species *C. scutellare*. Nevertheless we found differences which justify a subspecific name for this animal, which is described later in this study.

Numerous males, but no satisfactory females, *S. G. B.-B.*, Great Longstone, 1918.

Class *CHILOPODA*.

Family **Lithobiidæ**, Newport, 1844.

Genus **LITHOBIUS**, Leach, 1814.

19. *L. forficatus* (Linné, 1758).

15-32 mm.

This large and active brown centipede has more than two teeth on each of the coxæ of the maxillipedes. Its seventh dorsal plate is not produced posteriorly. The anal legs are stout. It is common all over the British Isles, under stones and in other damp situations. We have previously (4) recorded it for the county, as it was sent to us from Great Longstone (1 ♀, *A. W. F.*, 13/x./15); *Dove Dale, *R. S.*, iv./12 (*J.*), *G.* 3172; *in a collection from Dove and Mill Dales, *R. S.*, 21/iv./14 (*J.*); near the R. Dove, ourselves, ix./16; Manners Wood, near Bakewell, *W. B. & S. G. B.-B.*, 6/vi./18; Burbage Hall, *S. G. B.-B.*, 27/v./18; Buxton and Bakewell districts, ourselves, 1918.

20. *L. variegatus*, Leach et Brölemann.

20 mm.

This large and truly British variegated centipede has more

than two teeth on each of the coxæ of the maxillipedes. Its seventh dorsal plate has angular projections from each end of its posterior border. The anal legs are slender. It is often to be found under stones in moorland districts. We do not seem to have met with it ourselves in the Carboniferous Limestone areas of Derbyshire in 1918.

*♂ ♀, Kings Sterndale, near Buxton, *R. S.*, in a recent year (*J.*), G. 3176; *in a collection from Dove and Mill Dales, *R. S.*, 21/iv./14 (*J.*); near the R. Dove, ourselves, ix./16; Manners Wood, near Bakewell, *W. B. & S. G. B.-B.*, 6/vi./18.

21. *L. melanops*, Newport, 1845.

Syn. *L. glabratus*, C. L. Koch, 1847.

10–16 mm.

A species, with numerous ocelli and 2+2 maxillipedeteeth, which has definite angular projections from the posterior borders of its ninth, eleventh, and thirteenth dorsal plates. It is not uncommon between the trunk and bark of rotting logs.

Burbage Hall, *S. G. B.-B.*, 27/v./18.

22. *L. crassipes*, L. Koch, 1862.

6–9 mm.

A small active brown centipede, with only twenty antennal segments.

*Dove Dale, *R. S.*, in a recent year (*J.*), G. 3165; near the R. Dove, ourselves, ix./16; Manners Wood, near Bakewell, *W. B. & S. G. B.-B.*, 6/vi./18; Bakewell district, ourselves, 1918.

23. *L. dubosqui*, Brölemann.

5.5–7 mm.

Another small species, not unlike *L. crassipes*, but provided with only three ocelli on each side of the head in typical cases.

The Vicarage garden, Ashford-in-the-Water, ourselves, 1918.

Family Scolopendridæ, Newport, 1844.

Genus CRYPTOPS, Leach, 1814.

24. *C. hortensis*, Leach, 1814.

Syn. *C. savignyi*, Leach, 1817.

15–25 mm.

A form intermediate in organization between *Lithobius* and *Geophilus*.

A few, Bakewell district, ourselves, 1918.

Family **Geophilidæ**, Leach, 1814.

Genus **GEOPHILUS**, Leach, 1814.

25. *G. carpophagus*, Leach.

Syn. *G. sodalis*, Bergsøe et Meinert.

G. condylogaster, Latzel, 1880.

41 mm.

This is a dark brown species of our well-distributed genus *Geophilus*. The pegs of the anterior ventral plates are prominent and the corresponding sockets comparatively small. We have not ourselves met with this species in the county.

*Dove Dale, *R. S.*, 21/iv./14 (*J.*).

26. *G. longicornis*, Leach, 1814.

Syn. *G. flavus* (De Geer, 1778).

40 mm.

A detailed examination of examples of this species will show that the true peg-and-socket or "carpophagous" structure is wanting in the ventral plates of the animal's body. This character is present in all its known English congeners.

*2 ♀ ♀, Castleton, *R. S.*, ix./13 (*J.*), *G.* 3135; near the *R. Dove*, ourselves, ix./16; 1 ♀ with forty-seven pairs of legs, Mannors Wood, near Bakewell, *W. B. & S. G. B.-B.*, 6/vi./18; Bakewell district, ourselves, 1918.

27. *G. insculptus*, Attems, 1895.

Syn. The name "*G. proximus*" has been used by other authors in this country and ourselves to record animals which undoubtedly belong to *G. insculptus*. The true *G. proximus*, C. L. Koch, 1847, is unknown to us.

25 mm.

In May and June we found *G. insculptus* to be a fairly common species, and we obtained a good number of specimens. The socket of the anterior ventral plates is large.

Buxton and Bakewell districts, ourselves, 1918; Burbage Hall, *S. G. B.-B.*, 27/v./18.

28. *G. electricus* (Linné, 1758).

45 mm.

This is an interesting species, not very common in the

north of England, but apparently well distributed. The specimen recorded below has sixty-nine pairs of legs, and is furnished with typical pores on the coxæ of the anal legs.

1, junior, Bakewell district, ourselves, 1918.

Genus BRACHYGEOPHILUS, Brölemann, 1909.

29. *B. truncorum* (Bergsoe et Meinert).

10–14 mm.

This is the type of the genus, which resembles *Geophilus*. In *Brachygeophilus* the sternites are without pore-fields, the coxal pores are much reduced, the species are very small, and the number of their somites is low and only slightly variable (6). In the case of *B. truncorum* there are three marked depressions on the surface of the anterior ventral plates. It is common in the north of England.

Near the R. Dove, ourselves, ix./16; Bakewell district, ourselves, 1918.

Genus STIGMATOGASTER, Latzel, 1880.

30. *S. subterraneus* (Leach).

Syn. *Himantarium subterraneum* (Leach).

90 mm.

A large species with a clearly defined central pore-field on the anterior ventral plates.

Bakewell district, ourselves, 1918.

Genus SCOLIOPLANES, Bergsoe et Meinert, 1866.

31. *S. acuminatus* (Leach, 1814).

20–34 mm.

This is one of the darker geophilids. The maxillipedes of this genus are sufficiently characteristic to distinguish it at a glance from *Geophilus*. In this species, according to Latzel (8), the male always (in Austria) has thirty-nine pairs of walking-legs; there were thirty-nine pairs in the example recorded below. It would appear that the female may have from forty-one to forty-seven pairs, though Latzel only knew them (*loc. cit.*) with forty-one to forty-three pairs.

1 ♂, near the R. Dove, ourselves, ix./16.

III. DESCRIPTIONS OF THE TWO NEW MILLIPEDES RECORDED ABOVE, WITH NOTES.

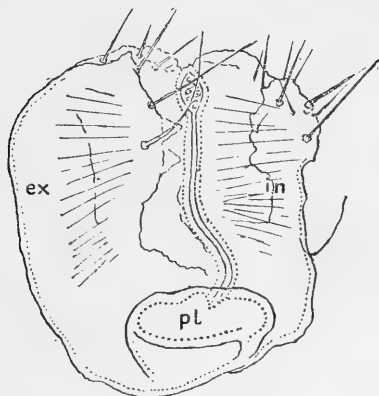
Brachychæteuma quartum, sp. n.

Dimensions approximately the same as those of the known species. Ocelli present, well but irregularly pigmented, few in number—three. The other external characters and the mouth-parts agreeing with the type of the genus. Male unknown.

Female.—The female presents the usual sexual differences.

The vulvæ.—In the “cyphopodite” the chitinization, both of the pilose lateral lobes (fig. 1, *ex*, *in*) and of the naked posterior lobe (*pl*), is well marked. The posterior lobe is

Fig. 1.



Brachychæteuma quartum, posterior view of the right vulva. *ex*, *in*, external and internal lobes of the “cyphopodite”; *pl*, posterior lobe. $\times 260$. H. K. B.-B. del.

simple in form, and is neither provided with a marked median elevation nor with lateral folds of chitin, though, as usual, the chitin of the posterior lobe as a whole is stouter than that of the rest of the organ. When viewed from behind the distal limit of the posterior lobe is almost flat and its lateral borders are simple, being convex in profile. From the same point of view a strong band of chitin is seen to arise from the external edge of the lobe at the height of its convexity; this band passes transversely towards the internal edge, and, losing its definition, hardly unites with it. A

short, proximally directed ridge of the same nature arises from a similar position on the internal border of the lobe.

Hab. Bakewell, wild, in a well-wooded Carboniferous Limestone district, under a stone.

Type. Slides 1275 and 1276, tube 1277, Brade-Birks collection.

It seems a convenient opportunity to give a diagnostic key to the females of the genus *Brachychæteuma*, as follows:—

- | | | |
|---|----|----------------------------------|
| 1 a. Posterior lobe (of the "cyphopodite") lacking a pair of definite circular thickenings of chitin | 2. | |
| 1 b. Posterior lobe furnished with a pair of definite circular thickenings of chitin .. | | [Birks. |
| 2 a. Posterior lobe with a marked median elevation | 3. | <i>B. melanops</i> , Brade- |
| 2 b. Posterior lobe without a marked median elevation | | |
| 3 a. Posterior lobe with a small median elevation and well-marked lateral folds of chitin | | <i>B. quartum</i> , nobis. |
| 3 b. Posterior lobe with a large and outwardly directed median elevation, but lacking lateral folds of chitin | | [Brade-Birks. |
| | | <i>B. bagnalli</i> , Verhoeff et |
| | | [et Brade-Birks. |
| | | <i>B. bradeæ</i> , Brölemann |

In the males of the genus it seems probable that development of the telepodite of the anterior gonopods runs parallel with the development of the posterior lobe of the "cyphopodite" in the vulva of the female. If that is really so, we should expect that when examples of the male of *B. quartum* are found, the telepoditic elements of the anterior gonopods will be similar to those of *B. bradeæ* and *B. bagnalli*—perhaps slightly less complicated; we should not expect the complex condition of the telepoditic horns found in *B. melanops*. In the species known previously the coxal prolongations of the anterior gonopods have been useful diagnostic features, and by analogy we should expect them to differ in *B. quartum* from those of the other species and to be simpler in form than in any of them. Thus, they should most closely resemble the coxal prolongations of *B. bagnalli**. The syncoxite of the same gonopods appears to be a fairly constant feature, and so it is to be expected that in this character and in the disposition of the pseudoflagella the male of *B. quartum* will agree with the other species.

* The coxal prolongations might, for example, be broader distally and less elevated than in *B. bagnalli*.

Chordeumella scutellare bagnalli, var. n.

Dimensions of the male.—Length 6.0, breadth 0.6 mm.

Other external characters.—In all essentials these are the same as those of *C. scutellare brölemanni*, though, perhaps, the new variety is rather darker dorsally.

Modified Appendages of the Male:

Anterior paragonopods (fig. 2).—These show characters intermediate between those of the type of the species and the variety *C. scutellare brölemanni*. The appendages are represented by a pair of conical processes, the coxal elements,

Fig. 3.

Fig. 2.

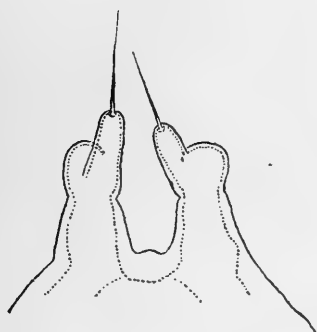
*Chordeumella scutellare bagnalli*.

Fig. 2.—Anterior paragonopods, $\times 260$. H. K. B.-B. del.

Fig. 3.—Sternite and left femorite of the anterior gonopods, $\times 260$. H. K. B.-B. del.

which bear long apical hairs. A definite indentation of the internal border of each paragonopod, due to an obtuse-angled inward bend of the appendage, corresponds in position to a feeble fold in the case of *C. scutellare scutellare*. The shoulder opposite the indentation is developed into a rounded pigmented naked projection on the external border of the limb. This projection is the rudiment of a telepodite, but the point of division between telepoditic and coxal elements is

nearer obliteration than is the case in *C. scutellare brölemanni*. Whereas in *brölemanni* the apices of the telepoditic and coxal elements are of about the same elevation, in this new variety the telepoditic element falls considerably short of the elevation of the coxite.

Anterior gonopods (fig. 3).—These, again, are intermediate in form between those of the type of the species and *brölemanni*. The sternite is furnished with a median prolongation, well developed and tongue-like in shape and simply rounded at its extremity, its distal border being neither emarginate as in *C. scutellare scutellare*, nor drawn out into a definite peak-like projection as in *C. scutellare brölemanni*.

Posterior gonopods, first pair of legs of the eighth segment, posterior paragonopods.—In all essentials these agree with the corresponding limbs of the type of the species; thus they also resemble those of *brölemanni*.

Female. Adult unknown.

Hab. Under wood, on a garden-path, etc., Beech House, Great Longstone, 1918.

Dedication. We have pleasure in naming this variety in honour of our friend and colleague Mr. R. S. Bagnall, F.L.S. etc., of Blayden-upon-Tyne.

Types. Tube 1271, slides 1272, 1273, 1274, and 1349, Brade-Birks collection.

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XXXII.—Notes on various Species of the American Genus *Astylus*, Cast., with Descriptions of their Sexual Characters [Coleoptera]. By GEORGE CHARLES CHAMPION, F.Z.S.

CERTAIN species of the Malacoderm genus *Astylus*, Cast. (= *Microglossa*, Solier) exhibit remarkable sexual characters, two only of which appear to have been specially noticed by authors, viz., the broad, vertical lamella on each side of the terminal abdominal segment in ♂♂ of *A. trifasciatus* and *A. gayi*, mentioned by Guérin, and the deeply emarginate, bispinose apices of the elytra in ♀♀ of *A. octopustulatus* and *A. antillarum*, observed by Gorham. The presence of these and other important external structures, accompanied by peculiarities in the ♂ genital armature (visible in many dried specimens), has induced me to examine the tegmen and ædeagus (penis-sheath *) of nearly all the species represented in the British Museum, or in that of the Hope Collection at Oxford. These chitinous structures are noticed in detail in the present paper; and in a number of cases the insect itself, owing to uncertainties of identification, is re-described, or named, if new. The principal external characters observed, apart from the longer antennæ or curved tibiæ of the males of certain species, are :—(1) the presence of two compressed, subconical, tuberculiform or dentiform prominences on the metasternum in ♂ (*A. octopustulatus*, *gorhami*, &c.); (2) the long, spiniform, anterior trochanters in ♂ (*A. subgriseus*); (3) the obliquely produced or dentiform inner apical angles of one or more of the intermediate joints of the anterior tarsi in ♂ (*A. antis*, *splendidus*, *correptus*, and *convexus*); (4) the posteriorly constricted elytra in ♂ (*A. correptus*); (5) the deeply emarginate, bispinose apices of the elytra in ♀ (*A. octopustulatus*, *gorhami*, *antillarum*, &c.); (6) the sinuato-truncated apices of the elytra, with sharp or dentiform sutural angle, in ♀ (*A. quadrilineatus*, *imbricatus*, &c.); (7) the elongate, conical, terminal, abdominal segment in ♂ (*A. sevmaculatus*, &c.); (8) the laterally lamellate terminal abdominal segment, and broadly divided fifth ventral segment, in ♂ (*A. trifasciatus* and *gayi*); (9) the forcipate terminal dorsal segment in ♂ (*A. forcipatus*).

The tegmen of the ♂ in many of the species is very deeply emarginate or cleft at the apex (*A. trifasciatus*, &c.); in others it is feebly emarginate (*A. octopustulatus*, &c.), truncated (*A. cyanerythrus*, &c.), or simply rounded at the

* Median lobe of Sharp and Muir.

tip (*A. correptus*); the margins of the distal portion of this organ are usually clothed with long curled hairs. The very elongate penis-sheath exhibits a variety of forms: (1) almost straight from near the base and simply pointed at the tip (*A. antis* and many other species); (2) broad, compressed, and obliquely truncate at the tip (*A. sexmaculatus*); (3) constricted distally, and obliquely truncate and sub-securiform at the tip (*A. vittaticollis*); (4) flattened and strongly bisinuate as seen in profile (*A. trifasciatus* and *gayi*). The long membranous sac, containing the true intromittent organ, has not been examined: the distal portion of it is usually seen protruding from the dorsal surface of the penis-sheath at some distance before the apex of the latter, and in some cases the exposed part appears to be studded with asperities or short bristles*. The terminal abdominal segment of the ♂ is separated from the preceding segment, on both the ventral and dorsal aspects, by a membranous space, extending broadly forward along the entire length of the fifth ventral segment in *A. trifasciatus*, *sexmaculatus*, &c., allowing great freedom of movement of this portion of the body during copulation. In several species a thickened hook-like process has been noticed on the front of the first ventral segment in ♂; but as this structure is almost covered by the posterior coxæ, and cannot be seen till the abdomen is detached, no use has been made of it in the present paper.

The genus *Astylus* extends over the greater part of South America, and is particularly well represented at high elevations in the Ecuadorean Andes, two species occurring as far north as Panama, and two in the Lesser Antilles. The large Chilean forms have been placed under a separate genus, *Mecoglossa*, by Solier, a name that might conveniently be retained for them, on account of the extraordinary genital armature of the ♂, and the cleft terminal ventral segment of the ♀. Since the publication of the "Munich" Catalogue of Malacodermata, in 1869, numerous species of *Astylus* have been described or named by Kirsch, Berg, Steinheil, Gorham, Bourgeois, and Pic. It is questionable whether one of the papers by the last-named author, entitled "*Sur le genre Astylus*, Cast." (*L'Echange*, xvii. pp. 34-36, 1902), containing many proposed new names for S. American forms, unaccompanied by definite descriptions or measurements, and issued solely—as the author states—to secure priority, should

* The genitalia examined have been dissected by Mr. A. Cant. To extract these pieces without injury, it has been found necessary to boil the detached abdomen in caustic potash.

be recognized*. These hairy insects are found gregariously on flowers in open places, and they bear a certain relationship to the Palearctic *Henicopus*, wanting the peculiar structures in the legs of the males so conspicuous in nearly all the members of the last-named genus. The two species found in abundance by myself in Chiriqui in 1881-83 are still the only known representatives of *Astylus* recorded from north of the Isthmus of Panama.

The forms represented in the British Museum collection may be grouped by their structural characters or ♂ armature thus :†—

- a*. Metasternum without tubercles or dentiform processes in ♂.
- a'*. Wings fully developed.
- a*². Terminal abdominal segment with broad vertical lamellæ in ♂, the segment itself transverse on the ventral aspect; sixth ventral segment divided in ♀; elytra more or less costate and rugosely punctured: ♂ with bilobed tegmen and strongly sinuate penis-sheath: species large, Chilean [*MECOGLOSSA*, Sol.] Nos. 1, 2.
- b*². Terminal abdominal segment without lamellæ, conical or narrowed posteriorly in ♂; sixth ventral segment divided in ♀; elytra not costate: ♂ of *A. sexmaculatus* with bilobed tegmen and broad, obliquely truncate penis-sheath Nos. 3, 4.
- c*². Terminal abdominal segment as in *b*²; sixth ventral segment not divided in ♀.
- a*³. Elytra not constricted posteriorly in either sex, at most obsoletely costate.
- a*⁴. Elytral apices rounded or obtuse in ♂ ♀, or (*A. vittatus*) obliquely truncate in ♀.
- a*⁵. ♂ with bilobed or emarginate tegmen and acuminate penis-sheath, the intermediate joints of anterior tarsi angulate at inner apical angle in *A.antis* and *splendidus*.
- a*⁶. Anterior trochanters simple in ♂ Nos. 5-22.
- b*⁶. Anterior trochanters long and spiniform in ♂ No. 23.
- b*⁵. ♂ with bluntly rounded or truncated tegmen and acuminate penis-sheath Nos. 24, 25.
- c*⁵. ♂ with bilobed tegmen and apically dilated penis-sheath No. 26.

* This article is catalogued in the 'Zoological Record' for 1902, p. 140, as "Notes on proposed n. spp.;" but the paper itself is not analysed, and the new names are not given.

† Males of *A. hæmatostictus*, *sevpustulatus*, *convexus*, and *amabilis* not dissected, those of *A. pallipes*, *imbricatus*, and *laticauda*, and female of *A. forcipatus* wanting.

- b*⁴. Elytral apices sinuato-truncate and sutural angles sharp in ♂ ♀*: ♂ with emarginate tegmen and acuminate penis-sheath No. 27.
- a*³. Elytra constricted posteriorly in ♂, subparallel in ♀, sharply costate laterally in both sexes: ♂ with joints 2 and 3 of anterior tarsi produced at inner apical angle, the tegmen rounded at tip, and the penis-sheath acuminate No. 28.
- d*². Terminal abdominal segment with a long process on each side in ♂, the tegmen truncate, and the penis-sheath acuminate; elytra bicostate; the inner costa prominent. No. 29:
- b*¹: Wings wanting or rudimentary; elytra not costate: ♂ with joints 2 and 3 of anterior tarsi produced at inner apical angle No. 30.
- b*. Metasternum bituberculate or bidentate in ♂; elytra uni- or bicostate; wings fully developed: ♂ with tegmen truncate or feebly emarginate and penis-sheath acuminate.
- c*¹. Elytral apices rounded or truncate in ♂, bispinose and deeply emarginate in ♀ Nos. 31-36.
- d*¹. Elytral apices rounded or subtruncate in ♂, sinuato-truncate, and with the sutural angles sharp and overlapping, in ♀ Nos. 37-39.

1. *Astylus trifasciatus*.

Dasytes (Astylus) trifasciatus, Guér. Icon. Règne Anim. p. 48, t. 15. figs. 2-2 c; Redt. Reise Novara, ii. p. 109.

Mecoglossa rugosa, Solier, in Gay's Hist. Chile, iv. p. 426, t. 10. figs. 5-5 g.

♂. Ventral sutures 1-4 oblique from the outer margin to median line; segment 1 with a stout hook in the middle at the base; segment 5 long, divided into two, widely separated, apically convergent lobes, which are broadly subtruncate at the tip, the median portion membranous. Terminal segment elongate on the dorsal aspect, transverse on the ventral aspect, angulate on each side towards the apex beneath, the apical portion dilated laterally into a broad, vertical, inwardly concave, securiform lobe, and the apical margin toothed in the centre above. Tegmen with moderately long, ciliate, feebly curved, lateral lobes, which are subtruncate or bluntly rounded at the tip. Penis-sheath very strongly, bisinuate curved, tapering at the tip.

♀. Ventral segment 6 about as long as 5, cleft, and separated laterally from the dorsal portion.

Hab. CHILE.

Apparently a common species in some parts of Chile.

* Possibly a variable character in this species, *A. quadrilineatus*.

This insect has extremely rugosely punctured elytra, and two more or less distinct costæ on the disc; the first and second fasciæ are usually connected with the dark sutural stripe, and the latter is sometimes dilated at the tip. The females are broader than the males, and some of them (labelled with the MS. name *Mecoglossa intermedia* in the Fry collection), from Lota, Chillan, &c., have much less coarsely punctate elytra. The long hairs on the under surface are cinereous in colour in the rugose form, and intermixed with black hairs in the smoother examples. The elytral markings are sometimes reduced to two spots on the outer part of the disc, the anterior one being quite small. Females largely preponderate in the long series before me, few of which are labelled with any definite locality.

2. *Astylus gayi*.

Dasytes (Astylus) gayii, Guér. Icon. Règne Anim. p. 48.

Mecoglossa affinis, Solier, in Gay's Hist. Chile, iv. p. 427.

Dasytes porrectus, Buquet, in Dej. Cat. 3rd edit. p. 123 (1837).

Hab. CHILE, Valparaiso (*C. Darwin*), Concepcion, San Blas, Coquimbo (*Mus. Brit.*), Araucania (*R. M. Middleton*), &c.

This insect is a smoother, very hairy form of *A. trifasciatus*, with the elytral markings usually reduced to three angular patches along the outer part of the disc and the sutural stripe dilated at the base and apex, and the long hairs on the under surface entirely or in great part black. The two forms have precisely similar ♂ armature, and the smoother females alluded to under *A. trifasciatus* would be equally well placed under either of them.

3. *Astylus sexmaculatus*.

Dasytes sexmaculatus, Perty, Del. Anim. art. Bras. p. 29, t. 6. fig. 15; Blanch. in Voyage d'Orbigny, vi. 2, p. 96.

Dasytes pictus, Dej. Cat. 3rd edit. p. 123 (1837).

♂. Ventral segment 1 with a blunt hook in the centre at the base; 5 broadly cleft down the middle, the lateral portions subtruncate at the tip. Terminal segment long, tubulate, narrowing outwards, emarginate laterally at the apex. Tegmen with long, spoon-shaped, slightly sinuous lateral lobes, which are curved inwards at the tip, and thickly fringed with long hairs. Penis-sheath stout, compressed, the outer portion broadly, obliquely truncate, as seen in profile.

♀. Ventral segment 5 short, triangular, emarginate, 6 cleft, shorter than 5.

Hab. BRAZIL, Rio de Janeiro (*Blanchard, Fry*), São Paulo (*Perty*), Alto de Serra Paulo (*G. E. Bryant*).

A long series seen, males preponderating, showing scarcely any variation, except in size. The penis-sheath of the ♂, examined in many specimens, is very different from that of any of the allied species dissected.

4. *Astylus hæmatostictus*, sp. n.

Elongate, narrow, shining, nigro-pilose above and beneath; nigro-cæruleous, the head and prothorax greenish, the elytra with an oblong spot at the base, the lateral margins to near the middle, a triangular postmedian patch on the disc, and a transverse subapical mark, luteous or reddish, the antennæ testaceous to about the middle; the head and prothorax finely, the elytra rather coarsely punctate. Head not much developed behind the eyes; antennæ moderately long in ♂, short in ♀. Prothorax transverse, rounded at the sides in both sexes. Elytra long, subparallel in their basal half.

♂. Ventral segment 5 broadly arcuato-emarginate, 6 moderately long, conical, cleft down the middle.

♀. Ventral segment 6 short, divided down the middle.

Length $6-6\frac{1}{2}$, breadth $2\frac{1}{2}-2\frac{3}{4}$ mm. (♂ ♀.)

Hab. BRAZIL, Minas Geraes (*Mus. Brit.*).

Described from a pair acquired by the Museum in 1844, the ♂ labelled with the MS. specific name *hæmatostictus*. An elongate, narrow, metallic insect, with nigro-cæruleous elytra, which are each marked with three rather large luteous or reddish spots—one basal (oblong), one postmedian (triangular), and one subapical (transverse). A larger abraded ♀ (length $8\frac{1}{4}$ mm.), from Puarcatambo, Peru, too imperfect to name, differs from the Brazilian insect in having the elytra less coarsely punctate, and the three spots transverse, the second forming a definite arcuate fascia. *A. hæmatostictus* seems to be nearest allied to *A. sexmaculatus*, Perty, from which it is separable by its smaller size, narrower form, and the differently shaped spots on the elytra. The unique male has not been dissected.

5. *Astylus antis*.

Dasytes antis, Perty, Del. Anim. art. Bras. p. 29, t. 6. fig. 13 (1833); Cast. Hist. Nat. Coleopt. i. p. 280.

Dasytes flavofasciatus, Blanch. in Voyage d'Orbigny, vi. 2, p. 97, t. 6. fig. 10.

Astylus fasciatus [Germ. in Dej. Cat. 3rd edit. p. 123], Sharp and Muir, Trans. Ent. Soc. Lond. 1912, pp. 540, 541 (♂ genit. armature).

♂. Anterior tarsi with joints 3 and 4 angulate, and 2 obliquely dentate, at the inner apical angle. Ventral segment 5 broadly, deeply emarginate. Terminal segment long, tubulate, narrowing from the base, cleft beneath. Tegmen narrowly cleft for a short distance at the apex, which is fringed with long hairs. Penis-sheath narrowed and somewhat acuminate at the tip.

♀. Ventral segment 6 short, undivided, feebly notched at the apex.

Hab. BRAZIL, Rio de Janeiro, Santa Catharina, São Paulo, Rio Grande, &c.; PARAGUAY, Sapucay (*W. Foster*); ARGENTINA, Corrientes (*sec. Blanchard*).

Of the twenty-five specimens before me, females preponderating, five belong to the smaller form with a relatively narrow prothorax in both sexes, this latter corresponding to the *D. flavofasciatus* of Blanchard, from Corrientes, Rio Grande, Sapucay, &c. A male of each has been dissected, and the armature proves to be precisely similar. The broad, complete, submedian flavous fascia on the elytra separates *A. antis* from *A. splendidus*. The prothorax and the base of the elytra are thickly set with long, erect or projecting, black hairs in both of them. The length varies from 10–16 mm.

6. *Astylus splendidus*.

Dasytes splendidus, Cast. Ann. Soc. Ent. Fr. 1832, p. 398; Hist. Nat. Coleopt. i. p. 280.

Hab. BRAZIL (*Mus. Oxon.*), Rio de Janeiro (*Fry*).

This is a large very brilliantly coloured form of *A. antis* with the flavous markings on the elytra reduced to an oblique subapical fascia on the outer part of the disc; the fascia, however in one of the five examples seen (2 ♂♂, 3 ♀♀) reaches the suture and is continued along it for a short distance forward. The ♂ characters are similar to those of *A. antis*, and the two insects are certainly nothing more than forms of one species. Both occur at Rio de Janeiro, where also the smaller and narrower *A. flavofasciatus*, Blanch., has been found.

7. *Astylus aulicus*.

Astylus aulicus, Dej. Cat. 3rd edit. p. 123 (1837); Pic. Bull. Soc. Ent. Fr. 1908, pp. 328, 329.

♂. Ventral segment 5 broadly, semicircularly emarginate 6 about as long as 5, undivided, with a narrow, deep, triangular

notch at the apex. Tegmen with two long, widely separated, straight lateral lobes, which are fringed with long hairs at the tip. Penis-sheath stout, acuminate and slightly upturned at the apex.

♀. Ventral segment shorter than 5, simple.

Hab. COLOMBIA; VENEZUELA.

A common insect in the countries quoted. The typical form has a transverse, angulate red patch on the outer part of the elytra before the middle, sometimes (var. *fenestratus*, Pic, l. c.) extending forward along the outer margin and up the middle of the disc to the base. Examples also occur with a small red spot at the base and one or two others beyond the middle. The ♂-characters are described from three specimens dissected many years ago by Dr. Sharp.

8. *Astylus rubripennis*.

Dasytes rubripennis, Latr. in Voyage Humboldt, i. p. 178, t. 17. fig. 3.
Melyris (Astylus) rubripennis, Er. in Wieg. Archiv für Naturg. xiii. 1, p. 84.

♂. Ventral segment 5 broadly arcuato-emarginate, 6 with an oblong excavation in the centre at the apex, and the apex itself deeply emarginate. Tegmen with short, broad lateral lobes, the apices of which are obliquely truncate and thickly set with long hairs. Penis-sheath stout, gradually narrowed and slightly curved at the tip.

Hab. ? COLOMBIA (*Mus. Brit.*); PERU, Jaen de Bracamorras (*Humboldt and Bonpland*).

Two males in the Museum labelled "Colombia" and acquired in 1844, agree with Latreille's figure of *D. rubripennis* and Erichson's subsequent description of the same species. The elytra have the reddish portion of the surface more extended than in *A. bonplandi*, leaving a broad, posteriorly angulate space at the base (enclosing an oval or oblong reddish patch), a small spot on the disc towards the apex, and the sutural and apical margins black. The very different ♂-armature shows that the two insects are distinct.

9. *Astylus bonplandi*.

Melytris (Astylus) bonplandi, Er. in Wieg. Archiv für Naturg. xiii. 1, p. 84 (1847).

Dasytes rubripennis, var., Latr. in Voy. Humboldt, i. p. 178, t. 17. fig. 4.

Astylus bonplandi, Bourg. Bull. Mus. Paris, 1911, p. 212.

♂. Ventral segment 5 broadly arcuato-emarginate, 6 un-

divided, with a small, deep, triangular notch at the tip. Tegmen with rather broad, long, lateral lobes, which are angularly dilated at the apex within, the apices clothed with black hairs. Penis-sheath almost straight from near the base, abruptly narrowed at the tip, the narrow apical portion slightly thickened distally.

♀. Ventral segment 6 simple, about as long as 5.

Hab. ECUADOR (*Buckley*), Chillalocha, Loja (*Bourgeois*), San Lucas, Quito (*ex coll. Fry*), ?Guayaquil (*Rosenberg*); PERU, Jaen de Bracamorras (*Humboldt and Bonpland*), Moyabamba (*ex coll. Fry*), Nauta; BOLIVIA.

To judge from the labels on the numerous examples before me, two or more species are confused in collections under the name *A. bonplandi*, after the elimination of *A. rubripennis*; and it is doubtful if much reliance can be placed on some of the Ecuador locality tickets, as it is scarcely likely that an insect ranges from the sea-level at Guayaquil to the elevated region of Quito. A moderately large, black, thickly nigro-pilose * form; the elytra red, with a common scutellar patch, an oblong patch at the shoulder (these markings sometimes coalescent posteriorly), two transversely-placed spots at the middle of the disc (often confluent and reaching the suture), a large spot below them, the sutural and apical margins, and the outer margin in part, black. In one or two examples the upper surface has a faint metallic tinge.

10. *Astylus cæruleotinctus*, sp. n.

Moderately elongate, shining, nigro-pilose; nigro-cæruleous, sometimes with a greenish lustre, the basal joints of the antennæ rufo-maculate; the elytra with an oval, posteriorly acuminate spot at the base, two transversely-placed patches before the middle (the inner one subtriangular or oval, and sometimes coalescent with the basal spot, the outer one extending forward along the outer margin to the shoulder), and a large, anteriorly subtruncate, complete or incomplete annulus before the apex, flavescent or red. Head small, somewhat deeply inserted into the prothorax, closely, finely punctate, hollowed in the middle between the eyes, the latter not very prominent; antennæ moderately long in ♂, shorter in ♀. Prothorax transverse, finely punctured, the margins strongly reflexed. Elytra rather broad, rounded at the apex, closely, somewhat coarsely punctate, sometimes with a faint costa on the inner part of the disc. Legs slender.

* Several examples in the Fry collection are completely abraded above.

♂. Ventral segment 5 deeply arcuato-emarginate, 6 conical, cleft down the middle to near the apex, leaving a narrow membranous space exposed. Tegmen with long, narrowly separated lateral lobes, which are somewhat spoon-shaped and flavo-ciliate at the tip. Penis-sheath rather slender, the outer portion straight, narrowly produced at the apex, the latter rounded.

♀. Ventral segment 6 short, simple.

Length 8-11, breadth 4-5 mm. (♂ ♀.)

Hab. COLOMBIA, Bogota; VENEZUELA; PERU.

Fifteen examples, including five males. A less robust, smaller insect than *A. bonplandi*, the surface constantly metallic, the elytral markings somewhat different, the sub-apical annulus always well defined, the legs more slender; the ♂ with the sixth ventral segment almost divided down the middle, and the lateral lobes of the tegmen undilated at the tip. Some of the specimens seen, both in the British Museum and in the Hope Collection at Oxford, are ticketed *A. (Dasytes) bonplandi* or *A. rubripennis*, Latr.; the three at Oxford are without locality-label.

11. *Astylus nigrolimbatus*, sp. n.

Moderately elongate, somewhat robust, shining, nigropilose; nigro-cæruleous, the basal joints of the antennæ rufo-maculate; the elytra with a space at the base (enclosing a transverse reddish spot), the suture thence to the tip, a triangular or transverse patch at about the middle of the disc (reaching the suture in one specimen), a rounded or sub-triangular patch below this, a patch at the apex, and the outer margin entirely of the ground-colour, the rest of their surface orange-yellow. Head, antennæ, and prothorax much as in *A. cæruleotinctus*, and the elytra similarly sculptured.

♂. Ventral segment 1 hooked in the centre in front, 5 deeply, semicircularly emarginate, 6 long, conical, with an elongate-triangular notch at the tip, without trace of median division. Tegmen with long, flattened lateral lobes, which are rounded and flavo-ciliate at the apex. Penis-sheath almost straight, somewhat abruptly narrowed at the apex, the protruding membranous sac studded with minute points.

♀. Ventral segment 6 short, simple.

Length $7\frac{1}{2}$ - $9\frac{1}{2}$, breadth $3\frac{1}{2}$ - $4\frac{1}{2}$ mm. (♂ ♀.)

Hab. ECUADOR (*ex coll. Fry*: ♀); PERU [type] (*ex coll. Fry*: ♂ ♀).

Three males and two females. This insect resembles the smaller examples of *A. bonplandi*, from which it is separable

by the transverse reddish basal spot and the entirely bluish-black outer margin of the elytra. The ♂ has a similarly undivided sixth ventral segment; but the lateral lobes of the tegmen are shaped much as in the same sex of *A. cæruleotinctus*, which has an incompletely cleft sixth ventral segment in ♂. The above-mentioned colour differences also distinguish *A. nigrolimbatus* from the last-named insect, the outer limb of the elytra being partly flavescent or red in all the specimens of *A. bonplandi* and *A. cæruleotinctus* before me.

12. *Astylus-bourgeoisii*.

Astylus bourgeoisii, Kirsch, Abhandl. Zool. Mus. Dresden, 1888-89, no. 4, p. 11, t. 1. fig. 20; Bourg. Bull. Mus. Paris, 1911, p. 212.

Astylus bissevguttatus, Gorh. in Whympers Great Andes, Suppl. App. pp. 52, 53, fig. (1891).

♂. Ventral segment 5 broadly arcuato-emarginate, 6 subtriangular, sulcate down the middle, notched at the tip. Tegmen narrow, with long, compressed, subcontiguous lateral lobes, which are ciliate and somewhat rounded at the tip. Penis-sheath with the outer portion almost straight, sulcate on the ventral aspect, abruptly narrowed at the apex.

♀. Ventral segment 6 short, simple.

Hab. COLOMBIA (*ex coll. Sharp*), Tuquerres (*sec. Kirsch*); ECUADOR, Quito, Cayambe, Mindo, Machachi, &c.

This variable insect is common at high elevations (8000-10,000 ft.) in Ecuador, many localities being given for it by Bourgeois and Gorham, who figure similar well-marked examples. The latter have on each elytron a patch at the base, two transversely placed, oblong spots towards the middle, and a large annulus before the apex, flavescent or red, these markings being sometimes reduced to small spots, three of which represent the broken-up annulus. The inner submedian juxta-sutural spot is rarely wanting, and the elytra themselves are coarsely punctured. Two dissimilarly coloured males have been dissected, showing no variation in the armature.

13. *Astylus riveti*.

Astylus riveti, Bourg. Bull. Mus. Paris, 1911, p. 213.

Moderately elongate, shining, pilose, the hairs on the upper surface mostly black, with shorter decumbent greyish hairs intermixed, those on the under surface and legs cinereous; æneous, the basal joints of the antennæ entirely or in part, and the others at the extreme base, rufous; the

elytra greenish, nigro-cæruleous, or black, with an elongate streak at the middle of the base, two or three shorter streaks (including one near the outer margin) below this, and a large irregular annulus before the apex, all sometimes coalescent or partly obsolete, flavescent or rufo-testaceous; the head, prothorax, and scutellum closely, finely punctate, the elytra foveolato-punctate, with minute punctures in the narrow interspaces. Head small, the anterior portion short; antennæ moderately long in ♂, shorter in ♀. Prothorax transverse, rounded at the sides in both sexes. Elytra subparallel to about the middle, the humeri tumid, the apical margin finely crenulate.

♂. Ventral segment 5 broadly arcuato-emarginate, 6 about as long as the lateral portions of 5, without groove, deeply, triangularly notched at the tip. Tegmen with long, compressed, narrowly separated, lateral lobes, which are rounded and flavo-ciliate at the apex. Penis-sheath pointed at the tip.

Length 6-7, breadth $2\frac{3}{5}$ - $3\frac{1}{2}$ mm. (♂ ♀.)

Hab. ECUADOR, Tioloma, alt. 4263 metres (*sec. Bourgeois*: type), Cañar (*Rosenberg ex coll. Fry*: ♂ ♀).

The above description is taken from four males and one female from Cañar, which vary greatly in the development of the elytral markings. *A. riveti*, Bourg., from Tioloma, based on a single example (♀?), seems to belong to the same species. The elytra in the insect before me are more coarsely punctured than in the allied *A. bourgeoisi*, Kirsch (= *bissex-guttatus*, Gorb.), a common species in the Andes of Ecuador, and equally variable in colour. In one example (♂) of the present insect the markings are entirely wanting on the basal half of the elytra, and in another (♀) the elytra (as in the type of *A. riveti*) are rufo-testaceous, with the sutural and outer margins, and four irregular angular patches black.

14. *Astylus seapustulatus*, sp. n.

Moderately elongate, shining, the elytra duller, sparsely nigro-pilose; nigro-æneous, the basal joints of the antennæ partly red, the elytra black, each with six sharply defined orange-yellow spots—one, transverse, rather large, at the base, one small, beneath the humeral callus (not visible from above), one oblong, subquadrate, lateral, at about the basal third, one, small, oval, near the suture, before the middle, one, oblique, on the outer part of the disc, beyond the middle, and one, rather large, triangular, near the apex; the head and prothorax closely, finely, the elytra very coarsely, punctured.

Head rather small; antennæ short in both sexes. Prothorax transverse, rounded at the sides. Elytra moderately long, without costæ; the apices, ♂ ♀, rather narrow, rounded, feebly denticulate.

♂. Ventral segment 5 deeply arcuato-emarginate, 6 subconical, moderately long.

Length $5\frac{1}{3}$ –6, breadth $2\frac{1}{5}$ – $2\frac{1}{3}$ mm. (♂ ♀.)

Hab. ECUADOR (*Rosenberg*).

One pair. Smaller than *A. bourgeoisi*, Kirsch (= *bissexguttatus*, Gorh.), the head narrower, the antennæ much shorter, the elytral markings very different, the six orange-yellow spots (one of which is not visible from above) precisely similar in the two specimens seen. The male, not dissected, doubtless has a bilobed tegmen.

15. *Astylus sexguttatus*.

Astylus sexguttatus, Kirsch, Abhandl. Zool. Mus. Dresden, 1888–89, no. 4, p. 11, t. 1. fig. 20.

♂. Ventral segment 5 broadly, semicircularly emarginate, 6 grooved down the middle. Tegmen with long, narrowly separated, rather broad lobes, which are ciliate at the tip. Penis-sheath attenuate; the apical portion beyond the aperture narrow.

Hab. COLOMBIA, Popayan and Jambalo (*sec. Kirsch*).

There is a ♂ of this species in the Museum received in 1855, labelled with the MS. name *A. bimaculatus*, Cht., and as from Guatemala, the locality being certainly incorrect. A brilliant, nigro-cæruleous insect, with six sharply defined flavous spots on each elytron, arranged 1, 2, 2, 1. *A. michaelisi*, Pic (1908), from Theresopolis, Brazil, seems to be more nearly allied to *A. sexguttatus* than to *A. sexmaculatus*, Perty, with which it is compared by its describer.

16. *Astylus luteoguttatus*, sp. n.

Moderately elongate, narrow and subparallel-sided (♂), or broader (♀), shining, pilose, the hairs on the under surface and legs cinereous; greenish-æneous, the elytra and ventral surface often nigro-cæruleous, the latter with a spot at the base, two others along the sides (the anterior one sometimes obsolete), another, transverse, before the apex, and sometimes two additional spots along the disc near the suture orange-yellow or rufous, the basal joints of the antennæ rufo-maculate; sparsely, finely, the elytra moderately coarsely punctate. Head rather narrow, well developed behind the

eyes; antennæ moderately long in ♂, shorter in ♀. Prothorax transverse, rounded at the sides in ♂, narrowed anteriorly in ♀. Elytra moderately long, the apices somewhat produced.

♂. Ventral segment 5 broadly arcuato-emarginate, 6 subconical. Tegmen with long, somewhat spoon-shaped, lateral lobes, their apices flavo-ciliate. Penis-sheath almost straight, subacuminate at apex.

Length 6-7, breadth $2\frac{2}{5}$ - $3\frac{1}{4}$ mm. (♂ ♀.)

Hab. ECUADOR, Loja (*Rosenberg*), Macas (*Buckley*); PERU (*ex colls. Murray and Fry*: type).

Fifteen examples, ten of which are from Peru, females preponderating, three out of the four from Loja having two additional reddish spots on the disc of the elytra near the suture. Recognizable by the metallic green or bluish elytra, with sharply-defined orange spots, the two near the suture evanescent, and the two submarginal ones often very small or wanting. *A. luteoguttatus* is allied to the Colombian *A. sexguttatus*, Kirsch, differing from the latter in its much smaller size, less robust build, shorter elytra, &c. *A. latemaculatus*, Pic, from Peru, seems to be the nearest ally amongst those indicated by him in 1902.

17. *Astylus luteicauda*, sp. n.

Moderately elongate, shining, pilose; nigro-æneous, greenish or æneous, the antennæ wholly or in part, the apices of the elytra, the tibiæ (except at the base), and tarsi testaceous or rufo-testaceous; the head and prothorax rather sparsely, the elytra very coarsely, punctate. Head elongated behind the eyes, and depressed in the middle between them, narrow in ♀, broader in ♂; antennæ long and rather slender in ♂, short in ♀. Prothorax transverse, broad and with the sides rounded in ♂, rapidly narrowed from near the base in ♀. Elytra subparallel, sometimes with an indication of a faint costa on the disc, the apical margin obsoletely crenulate.

♂. Ventral segment 5 broadly arcuato-emarginate, 6 conical, notched at the tip. Tegmen with long, compressed lateral lobes, which are rounded and flavo-ciliate at the tip. Penis-sheath straight, pointed at the apex.

Length 5-6, breadth $2\frac{2}{5}$ - $2\frac{4}{5}$ mm. (♂ ♀.)

Hab. ECUADOR, Loja and Zaragura (*Rosenberg ex coll. Fry*).

Three females and two males. This insect must be nearly

related to, and perhaps a form of, the Peruvian *A. nigrofemorialis*, Pic*, which is said to have the elytra luteo-trilineate at the base and luteo-maculate at the apex. The last-named species is compared by him with *A. pallipes*, Kirsch, from Ecuador. The longer head (especially in ♀), rufo-testaceous tibiae and tarsi, less coarsely punctured elytra, &c., separate *A. luteicauda* from *A. riveti*, Bourg. in all its varieties. The ♂-armature is very similar in the two forms. *A. (Dasylus) xanthurus*, Blanch., from Maldonado, also has a yellowish tip to the elytra.

18. *Astylus variegatus*.

Dasylus variegatus, Germ. Ins. Spec. nov. p. 77 (1824); Cast. Hist. Nat. Col. i. p. 280²; Blanch. in Voyage d'Orbigny, p. 97³.

Astylus variegatus, Redt. Reise Novara, ii. p. 109⁴.

Astylus variegatus, Germ., var. *notatus*, Pic, L'Echange, xvii. p. 36 (1902)⁵.

? *Astylus atromaculatus*, Blanch., var. *revoili*, Pic, L'Echange, xvii. pp. 35, 36 (1902)⁶.

Var. Larger, the head and prothorax black, the elytra reddish, with the black median patch curving downwards posteriorly and coalescent with the sutural stripe; all the tibiae more or less curved in ♂.

♂. Anterior and intermediate tibiae curved. Ventral segment 5 broadly arcuato-emarginate, 6 conical, undivided, deeply, triangularly notched at tip. Tegmen with very long, somewhat spoon-shaped lateral lobes, which are flavo-ciliate along their lower margin and at the apex. Penis-sheath stout, acuminate at apex.

♀. Ventral segment 5 feebly emarginate, 6 transverse.

Hab. BRAZIL¹²⁴⁵, Rio de Janeiro³⁶, Minas Geraes, Pernambuco, São Paulo, Rio Grande; PARAGUAY, Sapucay (*W. Foster*); ARGENTINA, Corrientes³.

Apparently an abundant insect in many parts of Brazil, especially about Rio de Janeiro, and often found gregariously on flowers. The larger and darker form (? *revoili*, Pic) has the lateral lobes of the ♂-tegmen rounded at the tip (not incurved and truncate as in *A. atromaculatus*), and shaped as in *A. variegatus*. The head and prothorax are usually metallic in the latter. The subapical spot on the elytra is sometimes obsolete, sometimes (var. *notatus*) united with the one on the opposite elytron into a common transverse patch.

* Mélanges exot.-entom. xii. p. 8 (Jan. 1915).

19. *Astylus atromaculatus*.

Dasytes atromaculatus, Blanch. in Voyage d'Orbigny, p. 97, t. 6. fig. 10.

Astylus atromaculatus, Blanch., var. *12-maculatus*, Pic, L'Echange, xvii. p. 36 (1902).

♂. Anterior and intermediate tibiæ curved. Ventral segment 5 broadly arcuato-emarginate, 6 about as broad as long, deeply, triangularly notched at tip. Tegmen with long, broad lateral lobes, which are incurved at the apex within, subtruncate or blunt at the tip, and flavo-ciliate along their lower and apical margins. Penis-sheath stout, acuminate at apex.

♀. Ventral segment 5 feebly emarginate, 6 transverse.

Hab. ARGENTINA (*O. W. Thomas*), Mendoza, Catamarca (*Mus. Brit.*), Tucuman (*cæ coll. Sharp*); BOLIVIA (*Mus. Oxon.*).

A close ally of *A. variegatus*, but differing from it in having the prothorax densely clothed with adpressed cinereous hairs (in addition to the long, erect, bristly, black hairs) at the sides and down the middle, the cinereous pubescence extending over the greater part of the dorsum in the Tucuman examples; the median and postmedian black patches on the disc of each elytron oblique and less rounded, the median patch more or less constricted at the middle and sometimes divided into two spots (the six spots being arranged 2, 2, 1, 1 = var. *12-maculatus*, Pic); the tegmen of ♂ with incurved more or less truncate lateral lobes. Living examples of this insect have been captured at Durban and Pretoria, doubtless introduced with hay during the Boer War. Blanchard gave no locality* for *A. atromaculatus*, but states that d'Orbigny found it in profusion on flowering lianas on the borders of woods. The Bolivian example in the Oxford Museum is labelled "*nigricollis* Hope."

20. *Astylus lineatus*.

Anobium lineatum, Fabr. Syst. Ent. p. 62¹.

Melyris lineatus, Oliv. Ent. ii. 21, t. 1. fig. 6².

Dasytes lineatus, Cast. Hist. Nat. Col. i. p. 281³; Blanch. in Voyage d'Orbigny, p. 98⁴.

Astylus lineatus, Redt. Reise Novara, ii. p. 109⁵.

♂. Anterior and intermediate tibiæ feebly curved. Ventral segment 5 deeply arcuato-emarginate, 6 conical, broader

* The "Munich" Catalogue incorrectly gives Brazil.

than long, truncate at the tip. Tegmen with very long, rather narrow, lateral lobes, which are slightly incurved and rounded at the apex, their lower and apical margins flavo-ciliate. Penis-sheath drawn out into a rather long slender point, which is thickened at the tip.

Hab. BRAZIL¹³, Rio Janeiro⁶ (*d'Orbigny*⁴, *C. Darwin*, *Fry*, &c.).

A common insect in Brazil. The long series examined shows scarcely any variation in the peculiar elytral markings. The type in the Banksian collection is a male.

21. *Astylus vittatus*.

Astylus vittatus, Gorh. Biol. Centr.-Am., Coleopt. iii. 1, pp. 127, 330, t. 7. fig. 9 (excl. example from Venezuela).

Astylus vittatus, Gorh., var. *chiriquensis*, Pic, *Mélanges exot.-entom.* xii. p. 7 (Jan. 1915).

♂. Elytra rounded at the apex. Ventral segment 5 deeply arcuato-emarginate, 6 moderately long, subconical, smooth, grooved down the middle posteriorly, and feebly notched at the tip. Tegmen bifurcate at apex, excavate at the tip above, the apical portion clothed with long, curled, blackish hairs. Penis-sheath acuminate at tip.

♀. Elytra obliquely subtruncate at the apex.

Hab. PANAMA, Chiriqui.

Found in abundance in Chiriqui. The variety has the flavous or reddish stripes (juxta-sutural and discal) on the elytra coalescent anteriorly, and the inner costa well defined. The metasternum is without tubercles in ♂. The sexes were not identified by Gorham. The unarmed apices of the elytra in ♀ separate *A. vittatus* from various similarly coloured forms.

22. *Astylus pallipes*.

Astylus pallipes, Kirsch, Abhandl. Zool. Mus. Dresden, 1888-89, no. 4, p. 11, t. 7. fig. 22.

Hab. ECUADOR, Quito (*ex coll. Murray*), Loma de Canamballo [type].

A female example from Quito, in the Museum, from the Fry collection, is evidently referable to this species. It is black, with the antennæ in great part, the tibiæ (except at the base), and tarsi testaceous; the elytra flavescent, with the suture, outer margin, two lines on the disc, and the tip black, the surface very coarsely punctured.

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23. *Astylus subgriseus*.

Astylus subgriseus, Pic, L'Echange, xvii. p. 35 (1902).

♂. Moderately elongate, shining, thickly clothed with rather long, adpressed, cinereous pubescence intermixed on the upper surface with long, erect, black, bristly hairs; nigro-æneous or nigro-cæruleous, the basal joints of the antennæ partly red, the elytra with three narrow luteous stripes—one near the suture and extending along it at the tip, one running down the disc to the middle, and narrowing from the base, and one marginal, complete; the head and prothorax closely, very finely punctate, with coarser punctures intermixed, the elytra roughly punctured. Head well developed behind the eyes; antennæ moderately long. Prothorax a little broader than long, strongly rounded at the sides, and much narrowed behind. Elytra moderately elongate, subparallel, somewhat abruptly and obliquely narrowed at the tip, the apices narrow, the sutural angles sharp. Legs long; anterior and intermediate tibiæ curved; anterior trochanters drawn out into a long, blunt, spiniform process, which is finely denticulate beneath. Ventral segment 5 deeply arcuato-emarginate, 6 elongate, subconical. Tegmen with very long lateral lobes, which are subtruncate, slightly incurved, and flavo-ciliate at the tip. Penis-sheath abruptly acuminate at apex.

Length $6\frac{2}{5}$ –7, breadth $2\frac{1}{2}$ –3 mm.

Hab. BRAZIL [type], Pernambuco (*Gounelle*).

Two males, each with the genital armature protruding. They are provisionally referred to the imperfectly described *A. subgriseus*, Pic, from Brazil, which is said to have three yellowish vittæ on the elytra, the one on the disc not reaching beyond the middle, and the suture black. It is the only species of the genus known to me with a long spiniform process extending outward from the anterior trochanters in ♂.

24. *Astylus cyanerythrus*.

Dasytes cyanerythrus, Perty, Del. Anim. artic. Bras. p. 29, t. 6. fig. 14¹.

Dasytes bifasciatus, Cast. Hist. Nat. Col. i. p. 280².

Dasytes rubrofasciatus, Blanch. in Voyage d'Orbigny, p. 97³.

♂. Ventral segment 5 broadly arcuato-emarginate, 6 about as long as broad, membranous in the middle at the base, triangularly notched at the apex. Tegmen broad, the outer portion comparatively short, bluntly rounded, unemarginate,

and fringed with long hairs at the tip. Penis-sheath stout, abruptly acuminate and hooked at the apex.

♀. Ventral segment 6 short, simple.

Hab. BRAZIL^{1,2}, Rio de Janeiro³, Santa Catharina, Bahia.

The seventeen examples of *A. cyanerythrus* before me (13 ♀ ♀, 4 ♂ ♂), belonging to the British Museum, or to the Hope Collection at Oxford, vary greatly in size (length $4\frac{1}{2}$ –10, breadth $2\frac{1}{2}$ – $5\frac{1}{2}$ mm.), and to some extent in colour. The two black patches on the disc of the prothorax are often transversely confluent, and the dark coloration sometimes extends over the whole dorsum, or leaves the basal margin only red; and the reddish submedian and subapical fasciæ on the elytra are very narrow in some examples, and not connected along the suture, differing in this respect from Perty's figure. Three of the specimens at Oxford are labelled with the MSS. names *annulatus*, K., *longicornis*, K., and *speciosus* respectively. A normal large ♂ (*speciosus* in Mus. Oxon.) has been dissected for examination of the mouth-parts and genital armature. It is possible that the smaller, darker, and more opaque form, also from Rio de Janeiro, may prove to be distinct? The synonymy quoted refers to the larger insect.

25. *Astylus jatahyensis*.

Astylus jatahyensis, Pic, L'Echange, xvii. p. 35 (1902).

Astylus jatahyensis, var. *armitagei*, Pic, Mélanges exot.-entom. xii. p. 8 (Jan. 1915).

Moderately elongate, rather convex, shining, the elytra duller, clothed with erect, black bristly hairs intermixed with scattered cinereous pubescence, the vestiture of the under surface long, cinereous; black, the antennæ in great part, the prothorax with the entire margin, the elytra with the sutural and outer margins and a narrow !-shaped streak running down the middle of the disc to near the apex, the coxæ, and legs (the tarsi, posterior femora, and posterior tibiæ in part excepted) testaceous; the head closely, the prothorax rather sparsely punctured, the elytra irregularly asperato-punctate, with the interspaces alutaceous. Head rather short and broad, arcuately impressed in front; antennæ moderately long. Prothorax transversely convex, hollowed in the middle at the base, shallowly sulcate posteriorly. Elytra not very long, parallel, with or without two feeble costæ on the disc, the apices narrow, rounded.

♂. Ventral segment 5 feebly arcuato-emarginate, 6 short, triangularly notched at apex. Tegmen truncate at tip. Penis-sheath acuminate.

Var. The elytra testaceous, with two blackish, abbreviated or interrupted streaks, one near the suture, the other submarginal (*var. armitagei*, Pic).

Length $4\frac{1}{2}$ – $5\frac{1}{3}$, breadth 2 – $2\frac{1}{4}$ mm. (♂.)

Hab. BRAZIL, Jatahy in Goyas (*Gounelle*), São Paulo (*ex coll. Fry*).

Pic's type, to judge from the brief note about it, would appear to want the narrow !-shaped streak extending down the disc of each elytron, conspicuous in the two males from Jatahy before me. The variety, represented by two examples from São Paulo in the Fry Collection, agrees with his brief diagnosis of *A. armitagei*.

26. *Astylus vittaticollis*.

Dasytes vittaticollis, Blanch. in Voyage d'Orbigny, p. 98 (1843).

? *Melyris quadriteniata*, Er. Archiv für Naturg. xiii. 1, p. 84 (1847).

♂. Antennæ rather slender, elongate, much longer than in ♀. Ventral segment 5 deeply arcuato-emarginate, 6 moderately long, subconical, with a narrow, deep, triangular notch at tip. Tegmen with long lateral lobes, which are rounded and clothed with long hairs at the apex. Penis-sheath, as seen in profile, obliquely dilated and subsecuriform at tip.

♀. Ventral segment 5 feebly emarginate, 6 shaped very much as in ♂.

Hab. BOLIVIA (*Mus. Brit.*: ♂ ♀), Chuquisaca [type]; ? CHILE (*Germain, ex coll. Fry*: ♂ ♀).

Very like the variable *A. quadrilineatus*, Germ., but with much more finely punctured elytra, the apices without tooth at the sutural angle in either sex; the prothorax (in fresh specimens) with a line down the middle and a space along the sides closely cinereo-pubescent, much as in *A. atromaculatus*, Blanch.; the antennæ long and slender in ♂, with the basal joints only testaceous; the genital armature very different.

Five specimens are before me, including a pair from Bolivia, a pair labelled "Chile" (a locality requiring confirmation), and a ♂, belonging to the Oxford Museum, labelled "*quadrivittatus*, Chev., Andes." *Melyris quadriteniata*, Er., from Peru, may be based upon a slightly worn example of the present species, the definition "elytris apice integris, crebre punctatis, subrugulosis" agreeing with *A. vittaticollis*.

27. *Astylus quadrilineatus*.

Dasytes quadrilineatus, Germ. Ins. Spec. nov. p. 76 (1825)¹; Blanch. in Voyage d'Orbigny, p. 98²; Cast. Hist. Nat. Col. i. p. 281³.

♂. Antennæ wholly or in part rufo-testaceous, moderately long, considerably longer than in ♀. Elytra more or less sinuate at the tip, and with the sutural angles almost as acute as in ♀. Ventral segment 5 deeply arcuato-emarginate, 6 barely as long as 5, subconical, feebly notched at tip. Tegmen more or less emarginate or bilobed, and clothed with long blackish hairs at apex. Penis-sheath gradually narrowed or acuminate at tip.

♀. Ventral segment 5 feebly emarginate, 6 short.

Hab. BRAZIL^{1, 2}, Santa Catharina (*ex coll. Fry*: ♀), Rio Grande; URUGUAY, Maldonado², Monte Video (*C. Darwin*); ARGENTINA (*O. W. Thomas*), Santa Fé and Bahia Blanca (*C. Darwin*), Buenos Ayres³; PATAGONIA².

A variable insect, if the specimens before me all belong to one species. The reddish or flavescent marginal and discoidal vittæ of the elytra are sometimes coalescent at the tip and the discoidal one may be reduced to a narrow incomplete line. Four males have been dissected, showing some variation in the form of the tegmen, which in a large example from Buenos Ayres has a short lobe on each side at tip. Two small males from Monte Video, with the sutural angles of the elytra obtuse and the tegmen rounded at apex, may belong to a different species? The length varies from 6-9 mm. The general colour may be bluish-green, green, nigro-cæruleous, or brassy.

28. *Astylus correptus*, sp. n.

Elongate, moderately broad, shining, nigro-pilose, with short, adpressed, cinereous hairs intermixed; black, the elytra (the humeri, basal portion of the suture, and apical margin excepted) brown; closely, minutely, the elytra finely, irregularly punctate. Head hollowed on each side anteriorly; antennæ strongly serrate, short in ♀, a little longer in ♂. Prothorax broader than long, narrowed anteriorly in both sexes, hollowed in the middle at the base. Elytra long, costate laterally to near the apex, and obsoletely bicostate on the disc; in ♂ somewhat rounded at the sides, and with the apical portion narrow and considerably produced; in ♀ subparallel to near the tip, and with the humeri much swollen.

♂. Anterior tarsi with joints 2 and 3 obliquely dentate and 4 angulate, and the intermediate tarsi with joint 3

dentate and 4 angulate at the inner apical angle. Ventral segment 5 arcuato-emarginate, 6 conical. Tegmen flattened, simple, narrow, rounded and entire at the tip. Penis-sheath slender, the outer portion straight, abruptly pointed at the apex.

Length $9\frac{1}{2}$ – $10\frac{1}{2}$, breadth $4\frac{1}{10}$ mm. (δ φ .)

Hab. COLOMBIA [φ] and VENEZUELA [δ] (*Mus. Brit.*).

One pair, acquired by the Museum in 1844, the δ bearing an inapplicable MS. name. The dissimilarity in the shape of the elytra in the two sexes, the elytra themselves being sharply costate laterally in both of them, the peculiarly formed anterior and intermediate tarsi of the δ (suggestive of the Palæarctic genus *Henicopus*), and the simple, narrow tegmen in the same sex, are characters of insufficient importance to remove *A. correptus* from *Astylus*. The δ , which must be taken as the type, has the facies of an *Omophlus*.

29. *Astylus forcipatus*, sp. n.

Moderately elongate, narrow, feebly shining, clothed with long, erect, bristly hairs intermixed with adpressed, scattered, cinereous pubescence, the vestiture of the under surface long, cinereous; black, with a faint brassy tinge, the antennæ, tibiæ, and tarsi testaceous; the elytra flavous, each with two broad vittæ extending from the base to the apical declivity (one dorsal, the other submarginal), and a spot before the apex, black; closely, finely, the dark portions of the elytra rugulosely, punctate, the punctures on the flavous portions conspicuous, and uniseriately arranged within the dorsal and marginal ridges. Head broad, the eyes large, prominent; antennæ moderately long. Prothorax transverse, narrowed anteriorly, canaliculate on the disc. Elytra parallel, bicostate, the inner costa stout, the submarginal one narrow, the apices obtuse.

δ . Terminal dorsal segment of abdomen with a long, stout, flattened, slightly sinuate process on each side, which is blunt at the tip and clothed with very long blackish hairs. Ventral segment 5 shallowly arcuato-emarginate, 6 short, deeply, triangularly excised. Tegmen narrow, truncate at the apex. Penis-sheath flattened, acuminate and somewhat spoon-shaped at the tip.

Length $4\frac{1}{2}$ – $5\frac{1}{2}$, breadth $1\frac{2}{3}$ –2 mm.

Hab. BRAZIL (*ex coll. Fry*).

Two males, injured by pinning, and both having the genital armature extruded. A small, narrow, parallel-sided

insect; the elytra flavous, with two broad vittæ (discoidal and submarginal), and a spot before the apex, black; the antennæ, tibiæ, and tarsi testaceous; the terminal dorsal abdominal segment with a long process on each side. *A. forcipatus* is not unlike the insect here identified as *A. jatahyensis*, Pic, and is somewhat similarly coloured—except that the prothorax is wholly black and the subapical spot on the elytra is testaceous (instead of black)—differing from the latter in having a rougher, less convex prothorax, a stout costa on the disc of the elytra, &c.*

30. *Astylus convexus*, sp. n.

Elongate oval, rather convex, very shining, sparsely pilose; metallic blue, the basal joints of the antennæ in great part rufo-testaceous, the elytra testaceous, with the suture narrowly and two broad stripes on the disc (united posteriorly in one specimen) cæruleous, the legs black; the head closely, finely, the prothorax sparsely, somewhat coarsely, and the elytra very coarsely, punctate. Head rather broad; antennæ (♂) long and comparatively stout, the joints longer than broad, in ♀ a little shorter. Prothorax transverse, ample, rounded at the sides, the margins strongly reflexed. Elytra moderately long, somewhat acuminate at tip, without trace of costæ, the humeri obtuse. Wings wanting. Legs moderately elongate.

♂. Anterior tarsi with joint 2 drawn out into an oblique tooth, and 3 angulate, at the inner apical angle. Ventral segment 5 deeply arcuato-emarginate, 6 short, notched at tip. Penis-sheath drawn out into a long point at apex.

Length 5–5½, breadth 2½ mm. (♂ ♀.)

Hab. PERU, Chanchamayo (*Thamm*).

One male and two females. A rather convex, apterous, metallic-blue insect, with testaceous, cæruleo-bilineate elytra. Not unlike *A. pallipes*, Kirsch, from Ecuador, but more convex, the antennæ longer and stouter, the prothorax more ample and with strongly reflexed margins, the humeral callus obsolete, the legs black, the wings (so far as can be seen without opening the elytra) wanting. This species may have to be removed from *Astylus*. The long antennæ, &c., separate *A. convexus* from the Chilean genus *Arthrobrachus*.

* In the Fry Collection there is a damaged ♂ of an allied larger form from La Paz, Bolivia, with entirely testaceous legs, the abdominal processes wanting, &c. It cannot be referred to *A. boliviensis* or *exclamationis*, Pic, from the same country.

31. *Astylus curvidens*, sp. n.

Elongate, shining, clothed with long, erect, black, bristly hairs intermixed with scattered adpressed cinereous pubescence, the vestiture of the legs and under surface cinereous; black, the basal joints of the antennæ partly red, the elytra with an oblong streak at the base, the outer margin to near the tip, and two stripes on the disc (one near the suture, abbreviated anteriorly, the other abbreviated behind and placed a little exterior to the basal patch, with which it is sometimes connected anteriorly), the sutural and marginal stripes transversely coalescent just before the apex, flavous or luteous; the head and prothorax densely, finely punctate, the latter with coarser punctures intermixed, the elytra roughly punctured. Head small, subrostrate, the eyes large; antennæ short, serrate, joints 7-10 about as broad as long, in ♂, transverse in ♀. Prothorax narrowed anteriorly. Elytra long, subparallel, costate from the humeral callus to near the apex, and also with an anteriorly evanescent costa on the disc; the apices in ♂ distinctly sinuate and with the sutural angle sharply produced, in ♀ very deeply emarginate, with the sutural and outer angles each produced into a long curved tooth, those at the sutural angles overlapping, the outer one very strongly arcuate.

♂. Metasternum with two compressed, conical, tuberculi-form prominences in the middle behind. Ventral segment 5 deeply arcuato-emarginate, 6 long, subcylindrical (with the dorsal portion forming a long tube, which is cleft laterally at the tip). Tegmen feebly bifurcate at tip, deeply sulcate at the apex above, the apical portion thickly clothed with long, curled, blackish hairs. Penis-sheath sharply pointed, curved upward at the tip.

Length 7-8½, breadth 2½-3 mm. (♂ ♀.)

Hab. VENEZUELA, Merida (*Rosenberg*: ♂ ♀); ? PERU (*ex Deyrolle*: ♂).

Three males and four females, the Peruvian habitat requiring confirmation. Extremely like *A. vittatus*, Gorb., from Chiriqui, but easily separable therefrom by the sexual characters: the ♂ with two compressed tubercles on the metasternum and the terminal abdominal segment elongated and subcylindrical; the ♀ with a very long tooth on each side of the apical emargination, the outer tooth arcuate, the inner one overlapping the corresponding tooth on the opposite elytron.

32. *Astylus antillarum*.

Astylus antillarum, Gorh. P. Z. S. 1898, p. 328, t. 27, fig. 7 (♂).

♂. Metasternum with two, curved, outwardly-directed, dentiform processes arising from a tumid space in the middle behind. Ventral segment 5 deeply arcuato-emarginate, 6 long, compressed (subcylindrical as seen in profile with the terminal dorsal segment).

Hab. ANTILLES, St. Vincent.

Described from a single pair—the ♂ now in the British Museum, the ♀ having passed into Pic's collection, from that of Gorham. The ♀ has the apices of the elytra deeply excised, as in the same sex of the allied forms. The spots are too red in the published figure.

33. *Astylus gorhami*.

♂. *Astylus gorhami*, Pic, *Mélanges exot.-entom.* xii, p. 8 (Jan. 1915).

Elongate, moderately shining, clothed with long, erect, black bristly hairs intermixed with scattered fine, adpressed, cinereous pubescence, the latter somewhat conspicuous along the elytral suture in ♀, the vestiture of the legs and under surface long, cinereous; black, the antennal joints more or less rufescent externally or at their base, the elytra each with a pyriform patch on the disc at the base, a mesially-constricted, apically widened, elongate streak on the disc below this, a subquadrate patch near the tip, and the outer margin in great part, orange-yellow; the head and prothorax densely, finely punctate, the latter with coarser, punctures intermixed, the elytra roughly punctured, smoother in the depressed juxta-sutural area in ♀. Head long, narrow, subrostrate; antennæ short, joints 7–10 transverse in ♀. Prothorax about as long as broad, narrowed anteriorly. Elytra long, sharply margined, costate laterally from the humeral callus to the common transverse apical depression, and with a faint costa on the disc also, the space between this and the suture and another within the outer ridge longitudinally depressed, conspicuously so in ♀; the apices blunt or subtruncate in ♂, and deeply semicircularly excavate (the sutural and outer angles thus appearing sharply dentate) in ♀.

♂. Metasternum with two compressed, curved, outwardly directed dentiform processes arising from a tumid space in the middle behind. Ventral segment 5 as long as 3 and 4

united, very deeply emarginate, 6 long, compressed. Tegmen slightly dilated and simply bifurcate at the tip, the apex set with numerous long, projecting, blackish hairs. Penis-sheath acuminate, curved upward at tip.

♀. Ventral segment 5 triangularly emarginate at tip, 6 short.

Length $7\frac{1}{2}$ –8, breadth 3 – $3\frac{1}{2}$ mm. (♂ ♀.)

Hab. ANTILLES, St. Vincent (*H. H. Smith, Lansdown Guilding*), and Union Island in the Grenadines (*H. H. Smith*).

Redescribed from five males and four females belonging to the British Museum or to the Hope Collection at Oxford, including a ♂ from St. Vincent found by Lansdown Guilding and a ♀ from Union Island, the others unlabelled, but all probably from St. Vincent. The specimen from the Grenadines, labelled *A. antillarum*, var.?, by Gorham, was not mentioned by him in his description of that species. It is strange that there should be two such closely allied forms in a small island like St. Vincent, but there is nothing intermediate in the series of *A. gorhami* before me, *A. antillarum* having the elytra spotted much as in *A. octopustulatus*. The emarginate, bidentate apices of the elytra is a character peculiar to the ♀ of these three insects, all of which have a bituberculate metasternum in ♂.

34. *Astylus amabilis*.

? *Astylus amabilis*, Pic, L'Echange, xvii. p. 35 (1902).

Elongate, shining, clothed with long, erect, black bristly hairs intermixed with scattered adpressed cinereous pubescence, the vestiture of the legs and under surface cinereous; black, the basal joints of the antennæ partly or almost entirely red, the elytra with a broad or moderately broad stripe extending down the disc to the apical depression, a transverse subapical patch, and the outer margin to near the apex, these markings sometimes coalescent posteriorly, flavous or orange-yellow; the head and prothorax closely, finely, the elytra roughly, punctured. Head small; antennæ short. Prothorax narrowed anteriorly. Elytra long, subparallel, costate laterally from the humeral callus, and with an indication of a faint costa on the disc; the apices in ♂ feebly subtruncate or rounded, in ♀ deeply emarginate, with the sutural angle drawn out into a long, narrow, nearly straight tooth and the outer angle into a shorter acutely

triangular one, the sutural tooth slightly overlapping the one on the opposite elytron.

♂. Metasternum with two compressed conical tubercles in the middle behind. Ventral segment 5 deeply arcuato-emarginate, 6 elongate, compressed.

Length $6\frac{1}{2}$ –8, breadth $2\frac{1}{2}$ – $3\frac{1}{5}$ mm. (♂ ♀.)

Hab. COLOMBIA (*ex coll. Fry*), Magdalena (*Mus. Brit.*).

A mainland form of the Antillean *A. gorhami*, Pic, the markings on the disc of the elytra united into an almost straight vitta, the tooth at the sutural angle in the ♀ elongated and longer than the outer one, which is also more acute. Three males and two females seen, one female bearing the MS. name *Dasytes spinosus*, Guér., and one male, ex Deyrolle, labelled *D. amabilis*, Dej. The apices of the elytra are truncate in two of the males and rounded in the third. This insect seems to be referable to the species briefly alluded to by Pic under the name *A. amabilis*: he describes the elytra as having a complete pale discal band and a narrow black tip. His type, from Colombia, was also obtained from Deyrolle, and under the same MS. name.

35. *Astylus octopustulatus*.

Astylus octopustulatus, Gorh. Biol. Centr.-Am., Coleopt. iii. 1, p. 330, t. 12. fig. 25 (♂).

♂. Elytra truncate at apex. Metasternum with the small dentiform processes arising from a tumid space in the middle behind. Ventral segment 5 very deeply emarginate, 6 long, compressed. Tegmen simply bifurcate and clothed with long, projecting, blackish hairs at tip. Penis-sheath drawn out into a long point at the apex.

♀. Elytra deeply emarginate at apex, the sutural and outer angles sharply dentate.

Hab. PANAMA, Chiriqui.

Gorham correctly identified the sexes of this insect, but he overlooked the metasternal dentiform prominences of the ♂, which are wanting in the same sex of his *A. vittatus*.

36. *Astylus lebasii*, sp. n.

Dasytes lebasii, Dej. Cat. 3rd edit. p. 124 (1837).

Elongate, narrow, shining, clothed with long, erect, black, bristly hairs intermixed with scattered adpressed cinereous pubescence, the vestiture of the legs and under surface

cinereous; black, the basal joints of the antennæ red, the elytra each with four longitudinally arranged spots on the disc—one at the base, acuminate-oval, one, oblong or slightly oblique, one, rounded or subtriangular, and one, transverse, subapical, the anterior two sometimes coalescent—and the outer margin to near the apex, flavous or orange-yellow; the head and prothorax closely, finely, the elytra roughly, punctured. Head small, the eyes rather large; antennæ short. Prothorax narrowed anteriorly. Elytra long, subparallel, sharply costate from the humeral callus downward, and also feebly costate on the disc; the apices in ♂ feebly truncate or rounded, in ♀ more or less emarginate, and with the sutural and outer angles dentiform.

♂. Metasternum with two small, compressed, subcontiguous tubercles in the middle behind. Ventral segment 5 deeply arcuato-emarginate, 6 long, compressed. Tegmen simply bifurcate and clothed with long, projecting blackish hairs at the tip. Penis-sheath drawn out into a long, slender point at the apex.

Length $5\frac{1}{4}$ –6, breadth $2\frac{1}{10}$ – $2\frac{1}{2}$ mm. (♂ ♀.)

Hab. COLOMBIA (*Mus. Brit.*), Carthagenæ (*Dejean Cat.*); VENEZUELA (*ex coll. Fry*).

Described from eight examples, four of each sex. The teeth at the apex of the elytra in ♀ vary in length, and the first and second spots on the disc are confluent in two of the specimens of that sex before me. This is the undescribed smaller Colombian form alluded to by Gorham in his description of *A. octopustulatus*. There is nothing intermediate in the long series of the latter examined, and the present insect may be distinguished from it by the elongated first and second spots on the disc of the elytra, approaching *A. gorhami* in this respect. The genital armature is very similar. *A. lebasii* is not mentioned by Pic in any of his various scattered papers on *Astylus*.

37. *Astylus hamatilis*, sp. n.

Elongate, narrow, shining, clothed with erect, black, bristly hairs intermixed with scattered fine adpressed cinereous pubescence, which is denser on the prothorax and elytral suture of ♀, the vestiture of the legs and under surface cinereous; black, the basal joints of the antennæ partly red, the elytra each with four longitudinally-arranged marks on the disc—one, pyriform, at the base, one, angulate or Λ -shaped, one, rounded or subtriangular (connected out-

wardly in one specimen with the angular mark), and one, transverse, subapical—and the outer margin to near the apex, orange-yellow, the head and prothorax closely, finely punctate, the latter with coarser punctures intermixed, the elytra roughly punctured. Head narrow; antennæ short, joints 7–10 transverse in ♀. Prothorax narrowed anteriorly. Elytra long, subparallel, costate laterally from the humeral callus to the apical declivity, and with an anteriorly evanescent costa on the disc; the apices narrow and rounded or subtruncate in ♂, a little wider, feebly emarginate, and with the sutural angle angularly dilated inwards so as to overlap the one on the opposite elytron, in ♀.

♂. Metasternum with two compressed conical tubercles in the middle behind. Ventral segment 5 deeply arcuato-emarginate, 6 long, compressed (subcylindrical as seen in profile with the terminal dorsal segment). Tegmen narrow, subtruncate at tip, which is slightly hollowed dorsally and clothed with long blackish hairs. Penis-sheath drawn out into a slender, feebly curved point.

Length $6\frac{1}{4}$ – $6\frac{1}{2}$, breadth $2\frac{1}{3}$ – $2\frac{2}{3}$ mm. (♂ ♀.)

Hab. VENEZUELA (*ex coll. Fry*).

Three males and one female, varying a little in the development of the elytral markings, two of them being coalescent in one specimen. Near *A. octopustulatus*, Gorb., the spots differently shaped, the second one on each elytron hooked, the tooth at the outer angle in the ♀ reduced to a feeble angulation, the dentiform sutural angle directed inwards and overlapping the one on the opposite wing-case.

38. *Astylus imbricatus*, sp. n.

♀. Black, the elytra with three rather broad flavous vittæ, the two on the disc connected anteriorly, the sutural and marginal ones broadly coalescent before the tip (leaving the apical margin narrowly black), and the median one slightly constricted posteriorly; the apices of the elytra sinuato-truncate, the sutural angle sharp and overlapping the one on the opposite wing-case; the elytral bicostate and rather coarsely punctate.

Length $5\frac{1}{5}$, breadth 2 mm.

Hab. VENEZUELA (*ex coll. Fry*).

One female. Smaller and narrower than the smallest example of *A. vittatus*, var. *chiriquensis*, the apices of the elytra truncate, with inwardly produced, acute, overlapping

sutural angles. The male probably has tubercles on the metasternum, these being present in the same sex of the nearly allied *A. curvidens*. The Venezuelan insect referred by Gorham to his *A. vittatus* may belong here?

39. *Astylus laticauda*, sp. n.

♀. Black, the elytra with an oblong spot at the base, a small spot on the disc at about one-third from the tip, a transverse patch midway between the latter and the apical margin, and the outer margin to about the middle, orange-yellow; the elytra bicostate, the apices broadly sinuato-truncate, with the sutural angle produced inwardly into a rather long tooth and the outer angle rounded; the other characters as in the same sex of *A. gorhami*, *A. antillarum*, *lebasi*, &c.

Length 7, breadth 3 mm.

Hab. VENEZUELA (*ex coll. Fry*).

One worn female, too different to be included under any of the allied forms as a colour-variety (the third spot on the elytra small and the second wanting altogether), owing to the broadly sinuato-truncate apices of the elytra and the inwardly-produced dentiform sutural angles.

Alphabetical list of species and varieties of *Astylus* enumerated in the present paper: the synonyms and varietal names are printed in italics, and the numbers of the species are placed in brackets after their respective names, an asterisk indicating the new forms:—

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|-------------------------------|-----------------------------|
| <i>affinis</i> (2). | <i>cyanerythrus</i> , 24. |
| <i>amabilis</i> , 34. | <i>12-maculatus</i> (19). |
| <i>annulatus</i> (24). | <i>fasciatus</i> (5). |
| <i>antillarum</i> , 32. | <i>fenestratus</i> (7). |
| <i>antis</i> , 5. | <i>flavofasciatus</i> (5). |
| <i>armitagei</i> (25). | * <i>forcipatus</i> , 29. |
| <i>atromaculatus</i> , 19. | <i>gayi</i> , 2. |
| <i>aulicus</i> , 7. | <i>gorhami</i> , 33. |
| <i>bifasciatus</i> (24). | * <i>hæmatostictus</i> , 4. |
| <i>bisseguttatus</i> (12). | * <i>hamatilis</i> , 37. |
| <i>bonplandi</i> , 9. | * <i>imbricatus</i> , 38. |
| <i>bourgeoisii</i> , 12. | <i>intermedius</i> (1). |
| * <i>cæruleotinctus</i> , 10. | <i>jatahyensis</i> , 25. |
| <i>chiriquensis</i> (21). | * <i>laticauda</i> , 39. |
| * <i>convexus</i> , 30. | * <i>lebasi</i> , 36. |
| * <i>correptus</i> , 28. | <i>lineatus</i> , 20. |
| * <i>curvidens</i> , 31. | <i>longicornis</i> (24). |

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|------------------------------|------------------------------|
| * <i>luteicauda</i> , 17. | <i>rubripennis</i> (9). |
| * <i>luteoguttatus</i> , 16. | <i>rubrofasciatus</i> (24). |
| <i>nigricollis</i> (19). | <i>rugosus</i> (1). |
| * <i>nigrolimbatus</i> , 11. | <i>sexguttatus</i> , 15. |
| <i>notatus</i> (18). | <i>sexmaculatus</i> , 3. |
| <i>octopustulatus</i> , 35. | * <i>sempustulatus</i> , 14. |
| <i>pallipes</i> , 22. | <i>speciosus</i> (24). |
| <i>pictus</i> (3). | <i>spinosus</i> (34). |
| <i>porrectus</i> (2). | <i>splendidus</i> , 6. |
| <i>quadrilineatus</i> , 27. | <i>subgriseus</i> , 23. |
| <i>quadrizeniatus</i> (26). | <i>trifasciatus</i> , 1. |
| <i>quadrivittatus</i> (26). | <i>variegatus</i> , 18. |
| <i>revoili</i> (18). | <i>vittaticollis</i> , 26. |
| <i>riveti</i> , 13. | <i>vittatus</i> , 21. |
| <i>rubripennis</i> , 8. | |

Horsell, Aug. 1918.

XXXIII.—On some External Characters of Ruminant Artiodactyla.—Part IV. The Reduncinæ (Cervicaprinæ) and Æpycerinæ. By R. I. Pocock, F.R.S.

As in the previous papers of this series published in the 'Annals' for June, August, and September of this year, the pagination subjoined to the specific headings refers to my treatise on the Cutaneous Glands of the Ruminants printed in the Proc. Zool. Soc. for 1910.

Subfamily REDUNCINÆ (olim Cervicaprinæ).

Genus PELEA.

Pelea capreolus, Bechst. (p. 911).

A second specimen of this species, which came into my hands since 1910, enables me to confirm in every particular the characters of the genus, based on external features, which I pointed out in that year.

Since this specimen, like the first, had no trace of inguinal glands, I think it may be assumed that Owen's statement as to their presence was false.

The only fact I have to add to my original description is that the false hoofs on both the fore and hind feet are united across the middle line.

Genus ELEOTRAGUS, Gray.

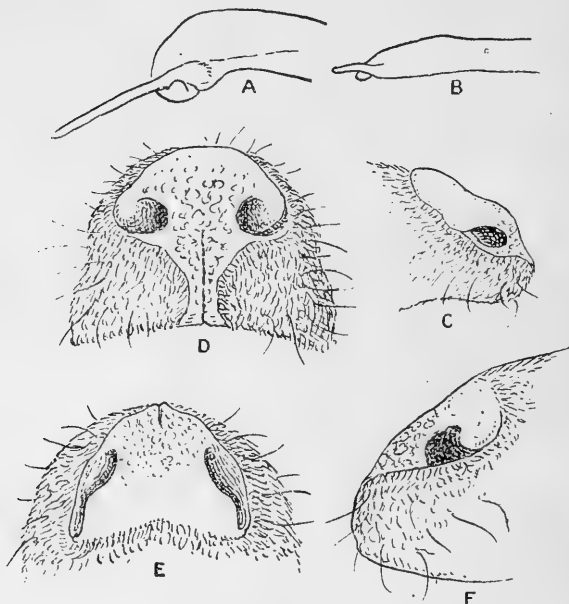
Eleotragus arundinum, Bodd.

In 1910 I was not in a position to incorporate an account

of this species in my paper. The examination, however, of an adult female specimen in 1911 revealed some interesting features connected especially with the rhinarium and inguinal glands.

The *rhinarium* (fig. 1, C), as in all the Reduncinæ, has a narrow philtrum, but it recalls that of *Pelea* in the backward extension of its upper surface a long way beyond the posterior angle of the nostrils. This area of it, however, is not so inflated as in *Pelea*.

Fig. 1.



- A. Extremity of penis of *Kobus defassa* from the left side.
 B. The same of *Redunca redunca*.
 C. Rhinarium of *Eleotragus arundinum* from the right side. $\times \frac{1}{3}$.
 D. The same of *Redunca redunca* from the front. $\times \frac{1}{3}$.
 E. The same from above. $\times \frac{1}{3}$.
 F. The same from the left side. $\times \frac{1}{3}$.

As in *Pelea*, there is no trace of preorbital glands, as Owen stated. In the *feet* the interdigital web is naked, as in *Pelea*, but there is no trace of pedal glands, and the false hoofs are not united, but separated by a narrow tract of naked skin. The feet, indeed, resemble those of *Adenota* and of most examples of *Redunca*:

Owen correctly recorded the presence of inguinal glands in this species, but gave no particulars. They are, as a matter of fact, peculiar. On each side of the mammæ, which are arranged in a quadrilateral, and rather far out from them, is a large orifice opening backwards and inwards, not outwards, and this leads into a pouch about 3 inches deep which runs obliquely forwards and outwards along the depression between the thigh and the abdomen. The area round the mammæ and the glands is naked, and the secretion of the glands has a starchy smell, like flour-paste.

For information as to the structure of the *penis*, see under *Redunca* (q. v. *infra*).

On the strength of the information regarding the rhinarium and inguinal glands I gave him in 1914, Mr. Lydekker (Cat. Ung. Mamm. ii. p. 203) granted subgeneric rank to *Eleotragus*. But, as I pointed out to him at the time, the characters which distinguish the type-species of *Eleotragus* from that of *Redunca* (olim *Cervicapra*) are quite sufficient for generic admission. The structure of the rhinarium affiliates *Eleotragus* with *Pelea*, and distinguishes it from *Redunca*. On the other hand, the absence of pedal glands and the presence of inguinal glands show affinity to *Redunca* and departure from *Pelea*. In the direction of the inguinal glands and in the presence of only a single pair, representing the shallow anterior pair of *Redunca*, *Eleotragus* is distinct from that genus.

GENUS REDUNCA (olim *Cervicapra*) *.

Redunca redunca, Pall. (p. 913).

A male example of this species from the Sudan (*G. Blaine*), and probably referable to the race described as *cottoni*, resembles in every particular, so far as the characters under discussion are concerned, the examples of the typical race of the species from Senegambia which I described in 1910.

The *rhinarium* (fig. 1, D, E, F), viewed from the front, has a convex upper margin; the nostrils are about as widely separated as in *Eleotragus*, and, as in that genus, there is scarcely a trace of naked skin below them; the philtrum is as wide above as the internarial septum, narrow inferiorly, and expands slightly where it passes into the gum of the upper lip; it is mesially grooved up to the level of the lower

* On the evidence supplied by Palmer, I follow Lydekker in adopting *Redunca* for *Cervicapra*, the latter being a synonym of *Antelope*.

border of the nostril, but there is no depression on the antero-superior surface of the rhinarium; the posterior edge of the upper surface of the latter is only slightly angular, the hairs of the muzzle extending in a nearly straight line across between the posterior angles of the nostrils. It is in this respect that the rhinarium differs so markedly from that of *Eleotragus*.

There is a bare patch of skin below the ear*.

Of the two pairs of *inguinal glands*, the anterior consists on each side of a wide but shallow pouch, and the posterior of a subcylindrical but dilatable pouch about 2 inches deep, the yellow secretion having a starchy smell.

Of the *pedal glands* no vestige remains; on the fore foot the false hoofs are united at the base, on the hind foot they are separated by a narrow strip of naked skin.

The *glans penis* (fig. 1, B) is slightly thickened towards the extremity, then gradually narrowed to a blunt point; the urethral canal is produced into a short slender tube overlapping the tip of the penis to a small extent. This penis is very like that of *Eleotragus arundinum* described and figured by Lönnberg (Ark. Zool. Stockholm, (5) v. no. 10, p. 6, fig. 5, 1909), except that the urethral process appears to be a little longer.

Genus ADENOTA, Gray.

Adenota kob, Erxl. (p. 915).

I have nothing to add to the description of this species published in 1910; but it is important to recapitulate the characters upon which the genus should be sustained, although Mr. Lydekker regarded it merely as a subgenus of *Kobus*.

It resembles *Kobus* in the structure of the rhinarium (*q. v. infra*) and in possessing a tufted instead of a bushy tail like that of *Pelea* and *Redunca*. It differs from *Kobus* in having a preorbital gland, consisting of a thickened area of skin, and a single pair of inguinal glands. In one of the specimens described in 1910 I recorded the presence of an additional vestigial or rudimentary inguinal gland, lying far out away from the mammæ, on the right side. This

* This patch was absent in the two examples of the typical race of this species described in 1910. This statement was evidently overlooked by Mr. Lydekker in 1914, when he cited the presence of this patch as one of the features distinguishing *Redunca* from *Kobus*. The naked patch is not glandular, but consists of very thin skin. Its function is unknown.

gland clearly represents one of the anterior pair present in *Redunca*. This very interesting fact shows that in *Adenota* representatives of the posterior pair of inguinal glands seen in *Redunca* are retained, whereas *Eleotragus* retains the homologues of the anterior pair of *Redunca*.

Genus *Kobus*, Smith.

Kobus defassa, Rüppell (p. 916).

In 1910 I was unable to publish reliable information as to the cutaneous glands of any species of the genus *Kobus*, having only the dried skin of the head of *K. defassa* and dried feet of *K. mariæ* for examination. Since that date I have been able to examine an adult male and female of *K. defassa* and an adult male hybrid between *K. defassa* and *K. ellipsiprymnus*.

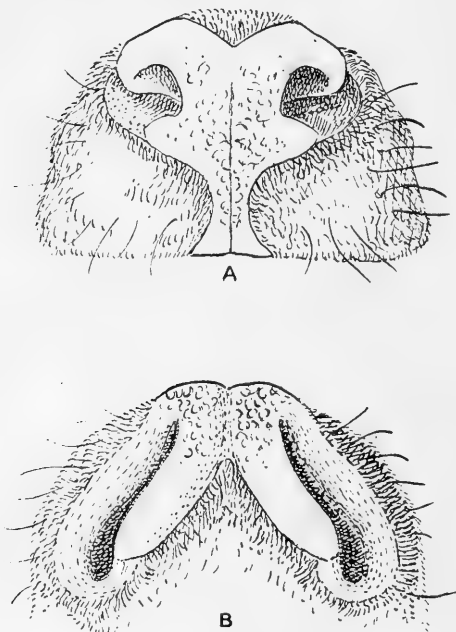
Preorbital gland.—Although I was unable in 1910 to discover a trace of this gland on the dried head-skin of *K. defassa*, I suggested the probability of the existence of a gland resembling that of *Adenota kob*. This suggestion, however, very clearly furnished no justification for Mr. Lydekker stating, on my authority, that rudimentary face-glands are present in the genus (Cat. Ung. Mamm. pp. 199 & 225, 1914). Fresh material proved my guess to be erroneous. *Kobus* resembles *Eleotragus* and *Redunca* in having no preorbital glands, as Owen long ago stated.

The *rhinarium* (fig. 2, A, B) was described by Mr. Lydekker as "normal." By this epithet he clearly meant unlike that of *Pelea* and *Eleotragus*. But, as a matter of fact, there are certain features about the *rhinarium* of *Kobus* which, according to my conception, are distinctly abnormal in the sense that, within the limits of the Reduncinæ, they are peculiar to the genera *Kobus* and *Adenota*, the *rhinarium* which most nearly approaches the normal in the Reduncinæ being found in *Redunca*. In *Kobus* the anterior surface of the *rhinarium* is bilobate, owing to the presence of a wide median depression up which the median groove of the philtrum extends as high as the summit of the anterior portion of the nares. There is also a wide area of naked skin passing beneath the nostrils to their posterior extremity laterally. Finally, on the dorsal side the hair of the summit of the muzzle encroaches as an angular field to a point nearly on a level with the anterior extremities of the nostrils, and on each side of this field the upper rim of the nostrils is elevated. The encroachment of this hair gives a biconvex

aspect to the upper edge of the rhinarium from the front aspect, the corresponding edge in *Redunca* being evenly convex from side to side. A rhinarium of this structure is found only in *Kobus* and *Adenota* within the limits of the Reduncinæ.

Inguinal glands are absent, as Owen stated, and there is no trace of *pedal glands*.

Fig. 2.



A. Rhinarium of *Kobus defassa* from the front. $\times \frac{1}{3}$.
 B. The same from above.

The extremity of the *penis* (fig. 1, A) is much more bulbous than in *Redunca*, with a downbent rounded apex, and the urethral canal is of unusual length, recalling that of *Ovis* in the extent to which it overlaps the end of the penis. The figures of the penis of this genus published by Lönnberg (Nova Acta R. Soc. Upsal. (3) xx. pl. ii. fig. 4, 1904) and by Gerhardt (Verh. Deutsch. Zool. Ges. xvi. p. 153, 1906) represent the urethral prolongation as curling up on the left side of the termination of the glans and

closely applied to it. It is also much shorter than in the specimen I examined.

By the characters described in this paper the genera of Reduncinæ may be distinguished as follows:—

1. *a.* Rhinarium swollen above and extending back far beyond posterior angle of nostrils. *Pelea, Eleotragus.*
a'. Rhinarium otherwise.
b. Rhinarium not deeply and widely grooved in front, extending as a narrow strip below nostrils laterally; its posterior border nearly straight between the nostrils..... *Redunca.*
b'. Rhinarium deeply grooved in front, a wide naked strip below nostrils laterally; its posterior border acutely angular between the nostrils..... *Adenota, Kobus.*
2. *a.* Preorbital gland absent..... *Pelea, Eleotragus, Redunca, Kobus.*
a'. Preorbital gland a thickened area of skin.. *Adenota.*
3. *a.* Inguinal glands absent..... *Pelea, Kobus.*
a'. Inguinal glands present.
b. Two pairs of inguinal glands..... *Redunca.*
b'. One pair of inguinal glands.
c. Anterior pair of inguinal glands of *Redunca* retained as long anteriorly directed pouches..... *Eleotragus.*
c'. Posterior pair of inguinal glands of *Redunca* retained as short inwardly directed pouches..... *Adenota.*
4. *a.* Pedal glands retained as flask-shaped sacs with short duct and small orifice..... *Pelea.*
a'. Pedal glands aborted..... *Eleotragus, Redunca, Adenota, Kobus.*
5. *a.* Penis with urethral tube short, slightly surpassing attenuated end of glans..... *Eleotragus, Redunca.*
a'. Penis with urethral tube very long, far surpassing bulbous end of glans..... *Kobus.*

Subfamily ÆPYCERINÆ*.

Genus ÆPYCEROS, Sund.

Æpyceros melampus, Licht. (p. 918).

The feet of a specimen of this species from British East Africa, brought home for me by Mr. F. C. Selous, enables

* I instituted this subfamily under this name in 1910; but Lydekker, while adopting the group in 1914 (Cat. Ung. Mamm. iii. p. 4), emended the title to Æpycerotinae, but quite unwarrantably, Æpycerinae being, I believe, correctly formed and having the advantage of brevity.

me to confirm my description of the metatarsal glands and to substantiate the correctness of my supposition as to the structure of the fore feet, published in 1910. The fore feet are exactly like the hind feet, except for the absence of the metacarpal glands. Pedal glands are absent. A piece of the skin of the inguinal region of the same specimen showed two pairs of mammæ, but no trace of inguinal glands, thus agreeing with the dried skins in the British Museum. Hence it may be concluded that Owen's statement that inguinal glands are present in the genus is erroneous; and since he affirmed at the same time the existence of large preorbital glands, which, according to universal testimony, are absent, it seems obvious that the specimen he examined did not belong to the genus *Æpyceros* at all, but was probably some large form of *Gazella*.

XXXIV.—*Diagnoses of new Bats of the Families Rhinolophidæ and Megadermatidæ.* By KNUD ANDERSEN.

[AT the request of Dr. Knud Andersen, who expects to be absent from his scientific work for some time, the following diagnoses are published, mostly in the form of extracts from the synopses of species prepared by him for the second volume of the 'Catalogue of Chiroptera.'

By this method the exact relationship of the species to their nearest allies is readily seen, together with the characters distinguishing them.

The "groups" in which the species of *Rhinolophus* are placed are those recognized (though under different names) in Dr. Andersen's "List of the Species and Subspecies of the Genus *Rhinolophus*"*, 1905.—O. T.]

Genus RHINOLOPHUS.

Rh. megaphyllus group. (Called *simplex* group in the 'Annals' paper, 1905.)

- a'. Connecting process higher posteriorly than anteriorly (at junction with sella).
- a². Ears longer, 16.5–21 mm. (inner margin).
General size larger; forearm 40–49 mm.
- a³. Nose-leaves larger: breadth of sella at base 2.5–3 mm., of horseshoe 9–10.5.

* Ann. & Mag. Nat. Hist. (7) xvi. p. 648 (1905).

Constriction at middle of sella always distinct.

- b³. Nose-leaves smaller; breadth of sella at base 2·2-3 mm., of horseshoe 7·7-9.

Constriction of sella often obsolescent.

- c⁴. Lancet cuneate or subcuneate.

- d⁴. Lancet hastate or subhastate (constriction of sella obsolescent or absent).

- e⁶. Nasal swellings 5·2-5·5 mm.; $c-m^3$ * 6·7-7·2 *borneensis*

- f⁶. Nasal swellings 4·9-5·2 mm.; $c-m^3$ 6·2-6·7. Lancet peculiarly shortened (probably nearest hastate), looking as if broader at base than long. Forearm 40-40·5 mm. (S. Java.)

javanicus, sp. n.

- b². Ears shorter, 15-16·5 mm. on inner margin. General size smaller; forearm 37-39 mm.

- c³. Connecting process as usual. Nasal swellings 4·6-4·8 mm.; $c-m^3$ 6·3-6·5. Forearm 38-39. (Madura.)

madurensis, sp. n.

- d³. Connecting process rather more pronounced than usual. Nasal swellings 4·3 mm.; $c-m^3$ 5·9-6·3. (Luzon.)

virgo.

- b¹. Connecting process broadly rounded off, as low posteriorly as anteriorly (at junction with sella). Sella distinctly expanded at middle, narrower at base than across expansions, constriction (at or above middle) very distinct.

- c². Forearm 46 mm.; tibia 20. Sella broader. (Bandon, Lower Siam.)

robinsoni, sp. n.

- d². Forearm 40-44 mm.; tibia 16-17. Sella narrower. (Pulo Tioman; P. Pemangil.)

klossi, sp. n.

Types:—

javanicus. Female. B.M. no. 9. 1. 5. 174. Original number 1655. Collected 18th March, 1908, by G. C. Shortridge at Pangandaran, Dirk de Fries Bay, S. Java. Presented by W. E. Balston.

madurensis. Female. B.M. no. 10. 4. 7. 9. Original number 2164. Collected 4th November, 1909, by G. C. Shortridge at Soemenep, E. Madura. Presented by Oldfield Thomas.

robinsoni. Female. B.M. no. 18. 8. 2. 1. Original number 527/13. From Kao Nawng, Bandon, Lower Siam, 13th June, 1913. Presented by the Federated Malay States Museum.

klossi. Female. B.M. no. 18. 8. 2. 2. From Pulo Pemangil, June 1915. Presented by the Federated Malay States Museum.

* $c-m^3$ = front of canine to back of m^3 .

Rh. pusillus group. (Called *lepidus* group in 1905.)

- u.* Connecting process like an erect (nearly equilateral) triangle, its front margin practically straight (non-concave).
- a'*. Smaller; forearm 33.5-43 mm. (*pusillus* subgroup.)
- a*². Skull and teeth larger; skull to front of canine 16.5-18.7 mm.; cond.-can.* 14.4-16.9; mandible 11-13.2; *c-m*³ 6.2-7.5. (*lepidus* series.)
- a*³. Base of fur of back paler, contrasting with the darker tips *lepidus*.
- c*⁴. Skull and teeth averaging larger; total length to front of canine 16.8-18.7 mm.; cond.-can. 15-16.9; *c-m*³ 6.5-7.5. Forearm 38-42.5. (Upper Burma.) *l. shortridgei*, subsp. n.
- b*³. Fur of back uniform from base to tip . *refulgens*.
- f*⁴. Sella subacute, its tip forming an equilateral triangle in front view. (Sumatra.) *r. cuneatus*, subsp. n.
- b*². Skull and teeth smaller; skull to front of canine 15.3-16.7 mm.; cond.-can. 13.5-14.8; mandible 9.8-11; *c-m*³ 5.5-6.4. (*pusillus* series.)
- (Fur of back pale at base. Sella conspicuously constricted at middle, markedly narrower at tip than at base.)
- a*³. Smaller, with relatively shorter tibia and smaller foot. Skull 15.3-16 mm.; cond.-can. 13.5-14.2; forearm 35.5-39.7; tibia 14-16; foot (c. u.) 7-8.
- a*⁴. Canines, *p*¹ and *p*₃ unmodified; *p*₃ sometimes external, but generally half or wholly in row. Forearm 35.5-39.7 mm. *blythi*, sp. n.
- a*⁵. Fur conspicuously pale above and below. (Kumaon.) *b. blythi*.
- b*⁵. Fur conspicuously darker above and below. (Darjiling to China.) [subsp. n.]
- b*⁴. Canines much heavier than in *a*⁴; *p*¹ and *p*₃ conspicuously reduced in size; *p*₃ generally external. General size as in *a*⁴. *b. szechwanus*,
- c*⁵. Teeth markedly larger; *c-m*³ 6.4 mm.; *c-m*₃ 6.7. (S. Liu-Kiu; Ishigaki.) *perditus*, sp. n.
- d*⁵. Teeth not larger than usual; *c-m*³ 5.5-5.7 mm.; *c-m*₃ 5.8-6.1. (Middle Liu-Kiu; Okinawa.) . . *pumilus*.
- b*³. Larger, with relatively longer tibia and larger foot. Tibia 16.5-17.5 mm. (Japan.) *cornutus*.
- b'*. Larger; forearm 44.5-51.5 mm. (*acuminatus* subgroup.)
- b.* Connecting process like an erect anteriorly curved horn, its front margin conspicuously concave (*garoensis* subgroup.)

* cond.-can. = length of skull from condyle to front of canine.

- a'*. Smaller. Skull, length to canine 15-15.2 mm. *garoensis*.
b'. Larger. Skull, length to canine 16.4-18 mm., $c-m^3$ 6.3-7; forearm 39-40.
c'. Smaller. Skull, length to canine 16.4-17 mm., condyle to canine 14.6-15.3, mandible 11.2-11.7, $c-m^3$ 6.3-6.7; forearm 39-39.5. (North Central Island, Andamans.) *famulus*, sp. n.
d'. Larger. Skull, length to canine 18 mm. (Port Blair, S. Andamans.) *cognatus*.

Types:—

- lepidus shortridgei*. Male. B.M. no. 18. 8. 3. 1. Original number 4015. Collected 12th October, 1913, at Pagan, R. Irrawaddy, Burma, by G. C. Shortridge. Presented by the Bombay Natural History Society. A large series examined. Also one from Kindat, Chindwin.
refulgens cuneatus. Male. B.M. no. 7. 1. 9. 3. From Sukaranda, Deli, Sumatra. Collected by Dr. H. Dohrn. Presented by the Museo Civico, Genoa. Paratype in Genoa Museum.
blythi. Female. B.M. no. 18. 8. 3. 2. Original number 3879. Collected 23rd October, 1913, at Almora, Kumaon, 5500', by G. M. Crump. Presented by the Bombay Natural History Society.
blythi szechwanus. Female. B.M. no. 13. 1. 26. 2. Collected at Chung-King, Sze-chwan, 27th Sept., 1912, and presented by Mr. W. R. Brown. Other specimens from Darjiling, Tahò, Burma, Yunnan, other localities in Sze-chwan, and Foochow.
perditus. Female. B.M. no. 5. 11. 3. 15. From Ishigaki, southern Liu-Kiu. Purchased of Alan Owston.
famulus. Female. B.M. no. 9. 4. 4. 8. From North Central Island, Andamans. Presented by the Indian Museum, Calcutta.

Rh. hipposideros group. (*midas* group, 1905.)

Rh. hipposideros—synopsis of subspecies:—

- a*. Infraorbital bridge linear (very rarely somewhat broadened) *minimus*, *hipposideros*, & *minutus*.
b. Infraorbital bridge broadened.
d'. Infraorbital bridge as a rule somewhat, though not often much broadened. Size about as in *minimus*. Forearm of *type* 37.5 mm. Skull, length to front of canine 15.5, condyle to canine 13.8, $c-m^3$ 5.6. (Corsica and Sardinia.) *majori*, subsp. n.

e'. Infraorbital bridge nearly always much broadened.

a². *p*₃ nearly always present. Size as *hipposideros*. (Gilgit to Cyprus.) *midas*.

b². *p*₃ nearly always absent. Size as *minimus*. Forearm of type 37 mm. Skull, length to front of canine 15·3, condyle to canine 13·6, *c-m*³ 5·5. (Morocco.) .. *escalerae*, subsp. n.

Types :—

majori. Male. B.M. no. 6. 4. 14. 3. Patrimonio, N. Corsica. Collected and presented by Dr. C. I. Forsyth Major.

escalerae. Female. B.M. no. 10. 11. 24. 2. Ha-ha, Mogador, Morocco. Collected by M. de la Escalera. Presented by Oldfield Thomas.

Rh. luctus group. (*philippinensis* group, 1905.)

c. Smaller; skull to front of canine less than 25 mm.; forearm 42·5–54.

c'. Ears shorter; from base of inner margin 20–23 mm. Nose-leaves smaller; breadth of horseshoe 9·5–10. Fur dark. Skull smaller and narrower, to front of canine 20·5–22; mandible 13·8–15; across *m*³ 7·2–7·8. Forearm 42·5–50.

a². Considerably smaller. (Borneo.) *sedulus*.

b². Considerably larger; canine to *m*³ 8·4–8·5 mm.; forearm 48·5–50. Infraorbital canal longer. (Malay Peninsula.)

edax, sp. n.
trifoliatulus, *niasensis*,
[*solitarius*].

d'. Ears larger; &c.

d. Larger; skull to front of canine more than 25 mm.; forearm 57–75·5.

e. Ear shorter, 28–30·5 mm.; forearm 57–63..

beddomei.

e². Averaging smaller; *c-m*³ 9·7 mm.; forearm 57. (Ceylon.)

b. sobrinus, subsp. n.

f². Averaging larger; *c-m*³ 10·2–10·8 mm.; forearm 59·5–63. (Indian Peninsula.) ..

b. beddomei.

f'. Ear longer, 34–39 mm.; forearm 63·5–75·5.

g². Ear smaller; &c.

morio.

c³. Ears averaging smaller. Colour generally darker. (Malay Peninsula.) ..

m. morio.

d³. Ears averaging larger. Colour generally lighter. (Borneo.)

m. foetidus, subsp. n.

Types :—

edax. Female. B.M. no. 7. 4. 18. 1. Singapore. Collected and presented by H. N. Ridley.

beddomei sobrinus. Female. B.M. no. 18. 8. 3. 3. Original number 1137. Collected at Kala Oya, N.C.P., Ceylon,

by Major E. W. Mayor. Presented by the Bombay Natural History Society.

morio fœtidus. B.M. no. 89. 1. 8. 4. Baram, E. Sarawak. Collected by Dr. Charles Hose.

euryotis group. (*arcuatus* group, 1905.)

- a. No special modification of hairing of posterior leaf *euryotis* subgroup.
- b. Median (intercellular) portion of posterior leaf clothed with long, semi-rigid, densely set hairs *creaghi* subgroup.
 - a². Posterior connecting process unmodified; hairs of posterior leaf bushy, not specially arranged *canuti*.
 - b². Posterior connecting process practically absent; hair of posterior leaf arranged in a conical tuft pointing towards posterior face of sella.
 - a³. P_3 and p^1 not smaller than usual; ears longer; forearm 48.5 mm. (Madura.).. *pilosus*, sp. n.
 - b³. P_3 rudimentary or wanting, p^1 reduced; ears smaller *creaghi*.

Type of *R. pilosus*:—Male. B.M. no. 10. 4. 7. 5. Original number 2162. Collected at Marengan, Soemenep, E. Madura, Java, 4th November, 1909, by G. C. Shortridge. Presented by Oldfield Thomas.

Asellia tridens diluta, subsp. n.

Like *A. tridens tridens*, but averaging larger, and colour of fur conspicuously paler.

Forearm 52.2 mm.

Skull: length to foot of canine 18.7; cond.-can. 16.6; $c-m^3$ 7; $c-m_3$ 7.7.

Hab. (of type). El Golea, Algerian Sahara. Other specimens from Biskra.

Type. Female. B.M. no. 12. 11. 14. 2. Original number 42. Collected 16th May, 1912, by Dr. E. Hartert. Presented by Lord Rothschild.

Genus HIPPOSIDEROS.

H. bicolor group.

- a. P_1 comparatively large, from $\frac{1}{2}$ to practically the full antero-posterior length of p_4 , its cusp always reaching above middle of cusp of p_4 ; internasal septum thick or even pear-shaped (thicker posteriorly).

- a'*. Smaller forms. Skull, cond.-can. 13-15.1 mm., $c-m^3$ 5-6; forearm 34-42.5.
- a*². Smallest. Skull, cond.-can. 13-13.8 mm., $c-m^3$ 5-5.5; forearm 34-40.2.
- a*³. Forearm 34-36.7 mm. (India, Burma, Borneo.) *cineraceus*.
- b*³. Forearm 37-40.2 mm. (Philippines.) *anticola*.
- b*². Larger. Skull, cond.-can. 13.8-15.1 mm., $c-m^3$ 5.5-6; forearm 37-42.5.
- c*³. Skull somewhat narrower in front; across canines 3.5-3.7 mm.
- a*⁴. Decidedly paler. Forearm 37-42 mm. (Sumatra, Java.) *bicolor*.
- b*⁴. Decidedly darker.
- a*⁵. Skull averaging smaller, cond.-can. 13.8-14.6 mm. Forearm 38-41.8. (Ceram, New Guinea, Port Albany.) *albanensis*.
- b*⁵. Skull averaging longer, cond.-can. 15.1 mm. Forearm 40-42. (Key Is.) *albanensis* [subsp. n. *sævus*, ×
- d*³. Skull somewhat broader in front; across canines 4-4.1 mm. Forearm 38.8-42.5. (Nicobars.) *nicobarulæ*.
- b'*. Larger forms. Skull, cond.-can. 15-16.7 mm., $c-m^3$ 6-6.8. Forearm 38.5-46.2.
- c*². Nose-leaves broader than usual. Horseshoe 5.8 mm., sella 5.2. Forearm 40.5. (Coorg.) *pomona*, sp. n.
- d*². Nose-leaves not broader than usual. Horseshoe 4.5-5.5 mm., sella 3.7-4.8 .. *gentilis*, sp. n. ×
- e*³. Smaller. Skull, cond.-can. 15-15.5 mm., $c-m^3$ 6-6.2; forearm 38.5-41.5. (Masuri, Burma, Pegu.) *g. gentilis*.
- f*³. Medium. Cond.-can. 15.7-16.3 mm., $c-m^3$ 6.2-6.7; forearm 40-46.2.
- c*⁴. Smaller: forearm 40-43 mm. (Siam, Fokien.) *g. sinensis*; subsp. n. ×
- d*⁴. Larger: forearm 42-46.2 mm. (Malay Peninsula.) *g. atrox*, subsp. n. ×
- (*g*³. Largest. Cond.-can. 16-16.7 mm., $c-m^3$ 6.5-6.8; forearm 44.8-46. (Nias, Engano.) *g. major*, subsp. n. ×
- b*. *P*₁ small, from a little less than $\frac{1}{3}$ to about $\frac{1}{2}$ the length (ant. post.) of *p*₄, its cusp below, or at most at the middle of the cusp of *p*₄; internasal septum very thin, narrowing into a sharp edge posteriorly.
- c'*. Forearm less than 44 mm.; $c-m^3$ below 6. Nose-leaves smaller.
- c*². Smaller. Forearm 35-37.3 mm. Ears shorter. (Ceylon and S. India.) *atratus*.
- d*². Larger. Forearm 38.5-43 mm. Ears larger. (Indian Peninsula.) *fulvus*.
- h*³. Colour of fur averaging darker. (Indian Peninsula as far north as Nasik.) *f. fulvus*.

- i³. Colour of fur paler. (Kathiawar, Cutch, Sind, Rajputana.) *f. pallidus*, subsp. n. x
 d'. Forearm 46 mm.; *c-m*³ 6·8. Nose-leaves larger, 6×8 mm. (Selangor.) *nequam*, sp. n.

Types:—

- albanensis sævus*. Female. B.M. no. 99. 12. 4. 12. From Key Is. Purchased of Rolle.
pomona. Male. B.M. no. 18. 8. 3. 4. Original number 2605. Collected by G. C. Shortridge at Haleri, N. Coorg, 15th February, 1913. Presented by the Bombay Natural History Society.
gentilis. Male. B.M. no. 93. 11. 15. 2. From Thayetmyo, Burma. Presented by Lieut. E. Y. Watson.
g. sinensis. B.M. no. 92. 2. 1. 3. From Foo-chow, Fo-kien. Presented by J. de La Touche, Esq.
g. atrox. Female. B.M. no. 1. 3. 9. 4. From Semangko Gap, Selangor, 2800'. Presented by A. L. Butler, Esq.
g. major. Male. B.M. no. 94. 1. 7. 6. From Bua-Bua, Engano Island. Collected by Dr. E. Modigliani. Presented by the Museo Civico, Genoa.
fulvus pallidus. Male. B.M. no. 18. 8. 3. 5. Original number 1636. Collected at Junagadh, Kathiawar, 21st Sept., 1912, by C. A. Crump. Presented by the Bombay Natural History Society.
nequam. Male. B.M. no. 85. 8. 1. 369. From Klang, Selangor. Collected by W. Davison. Presented by A. O. Hume.

H. diadema group.

- A. Skull in front of sagittal crest concave; mesopterygoid space broader, palatine angle broadly rounded off; lateral vertical ridges of posterior leaf obsolescent *diadema* subsection.
 a. Smaller *demissus*.
 b. Larger *diadema*.
 a². Averaging smaller: *c-m*³ 11·3–13·6 mm. Three supplementary leaves.
 a³. Forearm 73–82·5 mm. *d. oceanites*, *d. pulla*-^{[tus.}
 b³. Forearm 76–87·5 mm.
 c⁴. Ears not larger than usual: length 27–28·5 mm., breadth 25–26·5.
 a⁵. Colour more brownish above and beneath. (Key Is.) *d. custos*, subsp. n. x
 b⁵. Colour powdered with greyish above and still greyer below *d. griseus*.
 d⁴. Ears larger: length about 30 mm., breadth 28·5–29·8.
 e⁵. Skull and dentition weaker: *c-m*³ about 12·3 mm. (Celebes.) *d. speculator*, subsp. n. x

- d*². Skull and dentition heavier: *c-m*³ 13.2-13.6 mm. (Gilolo.) *d. euotis*.
- B. Skull in front of sagittal crest convex or flattened; mesopterygoid space narrower; palatine angle acute or subacute; upper border of posterior leaf trilobate; lateral vertical ridges strong *lankadiva* subsection.
- c*. Larger. (Ceylon.) *lankadiva*.
- d*. Smaller. (Indian Peninsula.) *indus*, sp. n.
- e*¹. Skull larger, length to front of canine 29.8-32.2 mm.; *c-m*³ 12.5-13.5. General colour dark brown or grey-brown.
- c*². External dimensions averaging smaller: forearm 77-84.5 mm.
- e*³. General colour above dark brown, base of hairs not white. (Kanara.) *indus indus*.
- f*³. General colour above grey-brown, base of hairs white. (E. Mysore.) *i. mixtus*, subsp. n.
- d*². External dimensions larger: forearm 82-88 mm. Colour as *f*³. (Hoshangabad, Saugor.) *i. unitus*, subsp. n.
- f*¹. Skull smaller, to front of canine 28.5-28.8 mm.; *c-m*³ 11.5-11.1. General colour above slaty, with white bases to hairs. (Bellary.) *schistaceus*, sp. n.

Types:—

- H. diadema custos*. Male. B.M. no. 10. 3. 1. 27. Original number 850. Collected July 1909 at Ara, Key Island, by W. Stalker. New Guinea Expedition.
- d. speculator*. Female. B.M. no. 97. 1. 3. 20. From Kalao, S. Celebes. Collected by A. Everett.
- indus*. Female. B.M. no. 12. 11. 28. 20. Original number 1109. Collected at Gersoppa, Kanara, 19th May, 1912, by G. C. Shortridge. Presented by the Bombay Natural History Society.
- i. mixtus*. Male. B.M. no. 13. 4. 11. 19. Original number 1747. Collected 18th September, 1912, at Kolar, E. Mysore, by G. C. Shortridge. Presented by the Bombay Natural History Society.
- i. unitus*. Female. B.M. no. 12. 11. 29. 20. Original number 1201. Collected 25th April, 1912, at Mundra, Saugor, C.P., 1600', by C. A. Crump. Presented by the Bombay Natural History Society.
- schistaceus*. Male. B.M. no. 13. 4. 10. 3. Original number 1462. Collected 26th July, 1912, at Vijayanagar, Bellary, by G. C. Shortridge. Presented by the Bombay Natural History Society.

H. speoris group.

The subspecies of *speoris* :—

- a. Skull, length to foot of canines 19–20·3 mm. (average of 108 specimens 19·7 mm.); forearm 49·8–54 (average 52). (Ceylon, Kanara, Bombay, Khandeish, Mysore.) *s. speoris*.
- b. Skull, length 18–19·8 mm. (average of 34 specimens 18·8 mm.); forearm 45·8–51·5 (average 49·4). (Bellary.) *s. pulchellus*, subsp. n.

Type of *H. s. pulchellus* :—Female. B.M. no. 13. 4. 10. 13. Original number 1473. Collected 27th July, 1912, at Vijayanagar, Bellary, by G. C. Shortridge. Presented by the Bombay Natural History Society.

H. calcaratus group.

H. cupidus, sp. n.

Nearly allied to *H. calcaratus*, but with teeth considerably smaller, canine to m^3 7·3–7·5 mm. as compared with 8·2–8·3 in *calcaratus*. Forearm in the immature type 46·2; in an adult from Jobi Island 49·2.

Type. Immature male. B.M. no. 97. 12. 6. 4. From Eaga, British New Guinea. Collected by A. S. Anthony. Presented by Lord Rothschild.

Genus MEGADERMA.

Subspecies of *M. spasma* :—

- a². Tibia averaging shorter, 27–28 mm. (Celebes, Philippines.) *M. s. spasma*.
- b². Tibia averaging longer, 28·5–33·5 mm.
- a³. Length of skull 24·4–26·3 mm.; lower jaw 16·9–18; $c-m^3$ 9·5–10. Forearm 54–58·5. (Java, Kangean, Sumatra, Borneo.) *s. trifolium*.
- b. As *trifolium*, but averaging perceptibly larger. Forearm 55–61·5 mm. (Malay Peninsula, S. Tenasserim.) *s. medium*, subsp. n.
- c. Maximum of size in the species; lower jaw 17·8–19 mm.; $c-m^3$ 10–10·8. Forearm 62–63. (Lower Chindwin.) *s. majus*, subsp. n.
- d. As *trifolium*, but more delicately built; lower jaw 16·6–17·3 mm.; zygomatic breadth of skull 13·7–14·3 mm. (against 14·3–15·5). Forearm 53·5–56·5. (Siam, Camboja.) *s. minus*, subsp. n.

- e.* Much like *trifolium*, but with narrower skull; zygomatic breadth 13·8–14·8 mm. Forearm 54–58·5. (Indian Peninsula.) *s. horsfieldi*.
f. As *s. horsfieldi*, but averaging smaller externally. Forearm 52–56·5 mm. *s. ceylonense*, subsp. n.

Types:—

- M. s. medium.* Female. B.M. no. 96. 4. 15. 1. From Singapore. Collected and presented by H. N. Ridley.
s. majus. Female. B.M. no. 18. 8. 3. 6. Original number 5354. Collected at Kin, Lower Chindwin, by G. C. Shortridge. Presented by the Bombay Natural History Society.
s. minus. B.M. no. 78. 6. 17. 42. From Camboja. Presented by M. Pierre.
s. ceylonense. Male. B.M. no. 18. 8. 3. 7. Original number 1317. Collected at Trincomalee by Major E. W. Mayor. Presented by the Bombay Natural History Society.

XXXV.—*Descriptions and Records of Bees.*—LXXX.

By T. D. A. COCKERELL, University of Colorado.

Xylocopa collaris, Lepeletier.♂. Sandakan, Borneo (*Baker*).

This is the form which Lepeletier described from Java as *X. dejeanii*. His *collaris* was based on females, doubtless of more than one race, but it may be restricted to the Malayan form, with Sumatra as the type locality.

Xylocopa collaris penangensis, subsp. n.

♂. (Type).—Similar to the Philippine *X. fuliginata*, Pérez, in having the light hair covering first and basal two-fifths of second segments of the abdomen, the lower margin straight. Otherwise it is like *X. collaris*, with pale hair on thorax above, except a narrow band along anterior edge of scutellum. The metathorax has black hair. In the colour of the hair on legs and apex of abdomen it resembles *X. collaris* var. *bryanti*, Ckll., from Java, but the wings are not darker than in typical *collaris*. The thorax dorsally is very faintly greenish. The pleura has pale hair on upper part and black on the lower. The insect is a little smaller than typical *collaris*.

♀.—Differs from *X. fuliginata* in being smaller (anterior wing 16.5 mm.), with the wings darker and brilliantly violet, and the thorax anteriorly with a band of white hair. The white thoracic band is narrower and less conspicuous than in *collaris*, and sends only a small and feeble extension to the pleura.

Island of Penang (*Baker*).

Mesotrichia bombiformis (Smith).

Manila, Philippine Is., Jan. 1, 1918 (*McGregor*).

The wings are much greener apically than in one from Los Baños.

Mesotrichia confusa viridissima, subsp. n.

♀. (Type).—Larger, anterior wing 23 mm.; anterior and posterior wings brilliant bluish green.

♂.—Yellow hair of thorax above brighter; second submarginal cell a little longer.

Island of Penang (*Baker*).

Pérez cites various localities for *confusa*; Singapore may be designated as the type locality. I have both sexes from Singapore, collected by Baker. The shorter wings of the females are violaceous, apically obscure green. Exactly the same thing, determined as *confusa* by Maidl, was received from the Berlin Museum, labelled "Sikhim (*Bingham*)."
It is unfortunate that some assistant at the Berlin Museum put "Sikhim" labels on numerous bees which never came from that region.

A specimen of *M. confusa* from Trong, Siam (*Abbott*), is intermediate between the type and *viridissima*, having the long wings of the latter, but with some violaceous colour, though they are mainly green. It is certainly nearest to *viridissima*.

Trigona geissleri, Friese.

I have a male from Sintang, North Borneo; and a couple of workers collected at Singapore by Baker appear to belong to the same species. It is a black insect, with broad abdomen; legs black, but trochanters red or reddish; scape clear ferruginous; front and mesothorax polished. It has some resemblance to *T. canifrons* and *T. laviceps*, but is clearly distinct. The Bornean male has the flagellum black, but in the Singapore workers it is ferruginous, more or less dusky above. The Singapore insect should perhaps

be separated, but we should first see Bornean workers. I have not seen any publication of *T. geissleri*, but it may have appeared in Germany since the mails from that country to America were discontinued.

Trigona pallidicincta, sp. n.

♂.—Length nearly 9 mm.

Head and thorax black, the clypeus, supraclypeal area, labrum, mandibles, upper border of prothorax, tubercles, and tegulæ pale ferruginous; antennæ black, scape red at extreme base; sides of face covered with appressed greyish-white hair; vertex with long dark fuscous hair; thorax with short pale hair at sides, but dorsally it is mainly fuscous; scutellum with a pale (tegumentary) patch posteriorly, and middle of metathorax suffusedly reddened; front not polished, except a triangular area in front of ocelli; mesothorax shining, with three impressed lines, the lateral ones deep. Wings hyaline, faintly reddish, stigma ferruginous, nervures fuscous. Legs very pale reddish basally, otherwise dark brown. Abdomen brown, darker apically; basin of first segment, and its broad apical margin, pale testaceous, the light colour sharply defined; base of third segment broadly pallid.

Singapore (*Baker*).

Resembles *T. castanea*, Bingham, but the wings are quite differently coloured. There is a rather strong superficial resemblance to the African *T. conradti*, Fr.

Trigona melanotricha, sp. n.

Worker.—Length about 7·5 mm.

Black, very robust, with rather long and coarse black hair; head broad; clypeus and mandibles obscure reddish; hair of face dark, the sides with thin appressed brown hair; front polished and shining; cheeks with thin brown pile; scape in front and flagellum beneath dull red, third antennal joint entirely bright ferruginous; mesothorax and scutellum shining; tegulæ dark reddish. Wings hyaline, basally orange-fulvous, nervures and stigma clear ferruginous; transverse-cubital nervures obsolete. Legs black, with coarse black hair; hind tibia very broad, fringed with very long black hair. Abdomen short and broad, shining, obscure reddish basally.

Sandakan, Borneo (*Baker*, 9222).

Related to *T. erythrostoma*, Cam., but quite distinct.

Trigona rufibasalis, sp. n.

Worker.—Length a little over 6 mm.

Rather slender, but the head broad. Black, with the mandibles dull red at apex, and tarsi red at apex; face with very thin greyish pile; front polished and shining; scape bright ferruginous; flagellum dark, reddish at extreme base, and red beneath at apex; mesothorax shining, without distinct impressed lines; hair of thorax above black but scanty; tegulæ piceous. Anterior wings with the basal half orange-ferruginous, the apical field clear; hind wings dusky throughout. Hind tibiæ not very broad for the genus. Abdomen shining black, venter with bands of black hair.

Sandakan, Borneo (*Baker*, 9225).

Somewhat related to *T. collina*, Sm., and *T. vidua*, Lep., but the wings are differently coloured, and the head and thorax are shining.

The above species of *Trigona* were received from Prof. C. F. Baker, with others from Sandakan, Borneo, and Singapore. The following key separates and records all the species represented in the series:—

- | | | |
|---|-------|------------------------------|
| Clear ferruginous. (Sandakan.) | ..... | <i>melina</i> , Gribodo. |
| At least the thorax or abdomen dark | ..... | 1. |
| 1. Mesothorax red, sometimes dark | ..... | 2. |
| Mesothorax pure black | ..... | 3. |
| 2. Face pale or red up to level of antennæ. (Sandakan.) | ..... | <i>apicalis</i> , Smith. |
| Only clypeus red. (Sandakan and Singapore, the malar space a little shorter in the Singapore form.) | ..... | <i>ambusta</i> , Ckll. |
| 3. Tegulæ clear testaceous; abdomen brownish. (Singapore.) | ..... | <i>pallidicincta</i> , Ckll. |
| Tegulæ darker | ..... | 4. |
| 4. Large species, with reddish clypeus, and wings basally orange-fulvous. (Sandakan.) | ..... | <i>melanotricha</i> , Ckll. |
| Smaller; or if rather large, clypeus black | ..... | 5. |
| 5. Scape black, except at extreme base; larger species | ..... | 6. |
| Scape ferruginous; smaller species | ..... | 7. |
| 6. Wings dilute fuliginous. (Singapore.) | ..... | <i>itama</i> , Ckll. |
| Wings not fuliginous. (Sandakan.) | ..... | <i>busara</i> , Ckll. |
| 7. Wings strongly reddened basally, apically hyaline. (Sandakan.) | ..... | <i>rufibasalis</i> , Ckll. |
| Wings greyish hyaline | ..... | 8. |
| 8. Larger; abdomen broad. (Singapore.) | ..... | <i>geissleri</i> , Friese. |
| Smaller; abdomen narrow. (Singapore.) | ..... | <i>valdezi</i> , Ckll. |

Megachile penangensis, sp. n.

♀.—Length about 11 mm.

Face below level of antennæ with black hair, front and

vertex with red hair, lower part of cheeks with white hair; thorax above and first abdominal segment with very bright red hair, thorax beneath with thin white hair; second abdominal segment with a narrow fulvous band, but rest of abdomen black and bandless; ventral scopa white, black on last two segments; antennæ black; mandibles quadridentate; legs black, with pale hair, red on inner side of tarsi and of anterior and middle tibiæ; tegulæ red. Wings deep fuliginous, hyaline basally.

Island of Penang (*Baker, 9277*).

Very close to *M. schauinslandi*, Alfken, and at first sight appearing identical, but certainly distinct by the much more closely and finely punctured abdomen. Prof. Baker sends me Hawaiian *M. schauinslandi*, determined by Friese as *M. umbripennis*, Smith, and this synonymy seems correct. *M. penangensis* nearly agrees with the description of *umbripennis*, but lacks the white hair-bands at sides of abdomen. Also from Penang comes *Megachile conjuncta*, Sm. (*Baker, 9273*).

Megachile facetula, sp. n.

♀.—Length about 11 mm.

Rather slender; black, including antennæ and legs, but tegulæ ferruginous; front, vertex, broad oblique bands from prothorax to below wings, and narrow sides of mesothorax, with bright ferruginous hair; lower margin of clypeus bituberculate in middle; mesothorax and scutellum very coarsely and densely rugosopunctate; ventral scopa white, black on last segment. Abdomen dorsally strongly punctured, segments 1-4 with lateral short bands of white hair, fifth with a narrow entire band. Wings basally hyaline, but otherwise dark fuliginous, splendidly iridescent, with purple colours.

Sandakan, Borneo (*Baker, 9278*).

This looks like *M. faceta*, Bingham, and is closely allied, differing by the narrower cheeks (from upper part of eyes to occipital margin much less than diameter of eye), sculpture of thorax not so coarse, and abdomen without metallic colours. Also from Sandakan comes *M. atrata fulvipennis* (Smith).

Megachile ramera, sp. n.

♀.—Length about 14 mm.

Robust; black, including antennæ, legs, and tegulæ; ventral scopa very bright ferruginous, white at extreme base; face, front, and vertex with black hair, a little white

about bases of antennæ and at each side of upper end of clypeus; cheeks with white hair; mandibles strongly keeled externally, the cutting-edge very long; clypeus broadly emarginate, the emargination crenulate, and with a median denticle; supraclypeal area flattened, polished and sparsely punctured in middle; clypeus rather closely punctured, with a smooth median line on upper part; thorax at sides, beneath, and metathorax with long white hair, but black hair in middle of mesopleura; mesothorax shining, strongly but not very densely punctured, appearing bare, but with short black hair, the lateral margins with white hair; scutellum with black hair, but a thin band of white between it and mesothorax. Wings dusky, nervures dark fuscous; tibial spurs ferruginous. Legs with mainly pale hair, ferruginous on inner side of the broadened hind basitarsi. Abdomen broad, with beautiful green and purple colours; hind margins of segments with narrow bright ferruginous hair-bands.

Singapore (*Baker*, 9274).

A beautiful species; closely related to the Australian *M. pictiventris*, Sm., but readily known by the red abdominal bands and the wholly black hair of front. Also from Singapore comes a female *M. subrixator*, Ckll. (*Baker*, 9275).

Megachile subignita, sp. n.

♀.—Length about 13·5 mm.

Not very robust; black, including antennæ and legs, tegulæ red; ventral scopa white at base, pale ferruginous in middle, black on last two segments; lower margin of clypeus gently arched, simple; clypeus densely punctured, with a smooth median line; front and sides of face with ferruginous hair, vertex with thin fuscous hair, lower part of cheeks with white; sides of mesothorax and scutellum, tubercles, upper part of pleura, and metathorax with long bright ferruginous hair; mesothorax and scutellum shining, strongly but not densely punctured, with thin fulvous hair on disc. Wings reddish dusky, nervures ferruginous, the outer ones becoming fuscous. Legs with pale hair; tibial spurs ferruginous; hind basitarsi not very broad, their inner side with red hair. Abdomen finely punctured, with greenish tints; hind margins of segments with narrow pale red hair-bands, sides of first segment heavily tufted with bright ferruginous hair.

Singapore (*Baker*, 9276).

In Friese's tables runs nearest to *M. penetrata*, Sm., but that is much larger, and otherwise different.

Paracolletes metallicus (Smith).

Males. Waipara, New Zealand, Nov. 21 (*Brittin*).

Halictus aerarius, Smith.

Males from Kobe, Japan (*Baker*).

Chelynia elegans (Cresson).

Estes Park Village, Colorado, June (*Hazel Andrews*).

Osmia pentstemonis, Cockerell.

Peaceful Valley, Colorado; at flowers of *Pentstemon*, July 5 (*Cockerell*).

Osmia hendersoni, Cockerell.

Tolland, Colorado.

BIBLIOGRAPHICAL NOTICE.

Life and Letters of Sir Joseph Dalton Hooker, O.M., G.C.S.I.
Based on Materials collected and arranged by Lady Hooker.
[With nine] Portraits and Illustrations. By LEONARD HUXLEY,
author of 'Life and Letters of T. H. Huxley,' etc. London:
John Murray, 1918. 2 vols. 8vo. i., pp. xi, 546; ii., vii, 569.
36s. net.

AMONGST the methods of writing a biography there are two which are pre-eminent—one, the strictly chronological, which leads the reader along as the subject lived, and enables him to trace the influences which moulded the life as they occurred, and the other, which may be termed the episodic method—by describing certain episodes of the life, and treating them fully, disregarding any overlapping of dates. The present work is largely on the second plan, probably wisely chosen, but having the disadvantage of rendering the sequence of dates at times somewhat difficult to follow.

Born in 1817 at Halesworth, Suffolk, of parents and grandparents of Norfolk birth, and having a botanical atmosphere from his early days, the future Sir Joseph Hooker passed his boyhood, University career, and early training in Glasgow. Four years on H.M.S. 'Erebus' in Antarctic Seas were followed by service on the Geological Survey as botanist, and then came a still more important journey in India, particularly amongst the Himalayas in Sikkim. Here his work was so thorough that, besides his large collection of plants and seeds, the map of Sikkim which he plotted proved of invaluable help to the British military expedition of 1903.

Ten years as assistant to his father, the Director of the Royal Botanic Gardens, Kew, were followed by twenty more as Director, and then by twenty-six of busy scientific labours unshackled by the claims of official administration, until that December day in 1911 when he was laid to rest beside his father in the churchyard on Kew Green, a veteran of 94 years, full of honours, with a splendid record of work.

His published works are proof of the power he possessed of pursuing his purposed path, in spite of absorbing official duties as head of the great national botanic institution, which owes so much to the two Hookers.

Where so much was accomplished it is hard to select for mention, but we may instance the six quarto volumes on the material brought home from the Southern Seas, '*Flora Antarctica*,' '*Flora Novæ Zealandiæ*,' and '*Flora Tasmaniae*,' 1844-60. Here we have not merely an enumeration of the plants, but in the '*Flora Tasmaniae*' we find a luminous exposition of distribution in space and time prefixed to the enumeration. His '*Himalayan Journals*,' 1854, form a fascinating record of his travels and captivity in that region. A faculty he possessed in singularly large measure, of methodizing facts and putting them into a convincing and lucid form, even on a small scale, and we note how he rapidly seized the important characters of plants and so described them, that his writings are readily utilized.

His masterly survey of Arctic plants (1861) shows how keen he was on questions of distribution, and his account of the plants of the Galapagos Islands (1849), both in the Linnean Society's '*Transactions*,' confirm this statement.

With Dr. Thomas Thomson (1817-78) he essayed a '*Flora Indica*,' 1855, but the experience gained in producing the single volume issued showed him that a work conceived on that scale was impossible of production. '*The Flora of British India*,' therefore, was planned on a more modest scale, and with other Indian botanists to help by undertaking assigned portions. The soundness of this procedure was proved by the finishing of this enumeration in seven octavo volumes, 1872-1897, an event marked by the striking and presentation of a gold medal by the Linnean Society in 1898.

The '*Genera Plantarum*,' 1862-83, which was worked up chiefly from material at Kew, in conjunction with George Bentham, was a monumental production, in which both of those distinguished phytographers contributed their ripe experience; it differed from its predecessors by being based upon actual examination of authenticated specimens or actual types, and was not merely literary compilation. The last big work on which Hooker started to engage was that termed '*Index Kewensis*,' which occupied thirteen years and a half from first to last. It was due to Charles Darwin, who induced Sir Joseph Hooker to get the work undertaken; he approved the plan submitted by the actual compiler, and acted as the channel by which the needful funds were received from Mrs. Darwin. As the work progressed and became available for

reference, Hooker's interest in it increased, and finally he went through the MS. to revise the geographical notes and read the proofs. Unluckily Mr. Darwin himself died within three months of the undertaking being put in hand.

With this activity in botanical publication, Hooker's influence in other directions must not be overlooked. He was Darwin's confidant for fifteen years before evolution was brought before the scientific world in July 1858. He spent five years as President of the Royal Society, 1873-78, with its consequent numerous committees, and served on the Council of the Linnean Society almost uninterruptedly from 1846 to 1884, and was Vice-President from 1861 to 1876 and 1882 to 1884, though he declined the Presidency in 1886, after his retirement from Kew.

Such is a rapid outline of Hooker's life, which is treated in detail in the two volumes before us. Mr. Leonard Huxley is well qualified as the biographer, being the eldest son of Prof. T. H. Huxley, F.R.S., Hooker's intimate friend, and, although it is not declared, is the godson mentioned on page 59 of the second volume. With the material already arranged by Lady Hooker, the connecting text became manageable, otherwise the bulk available might have proved insuperable.

Many portraits are extant, in various media; that reproduced as the frontispiece to the first volume is, perhaps, the least satisfactory, Hooker himself pronouncing it "lackadaisical," the very word the present writer had always applied to it.

In so long a work it is not surprising that slips occur—some due to the printer, but not all. Here are a few, which should be corrected in a second issue. The "S. J. Klotzsch" mentioned in the note in vol. i. p. 25 was Johann Friedrich Klotzsch (1805-60). The name "*Osmanthus*" on page 367 of the same volume must be meant for "*Osmothamnus*." What was the date of the letter cited? It must have been after 1882, when *Rhododendron anthopogon* was printed in the 'Flora of British India,' with *Osmothamnus fragrans* and *O. pallidus* as synonyms.

In the second volume, on page 247, line 23, the name should read Maingay, and p. 447, *Mougeotii* and *Mnium*; while such slips as "splendid" and "Penguins" are simple press errors.

There are two Cunninghams curiously confused in the Index, ii. p. 527; in vol. ii. David Douglas Cunningham (1843-1914) is referred to on p. 427, note, but his brother Robert Oliver Cunningham (1841-1918) on p. 80, and 101, note.

We close the volumes, which have recalled the memory of many vanished botanists, with gratitude to the writers whose labours have done so much to place on permanent record the great and strong personality which Hooker's surviving contemporaries must always remember with pleasure. It was indeed their good fortune to have been associated with so commanding a figure. B. D. J.

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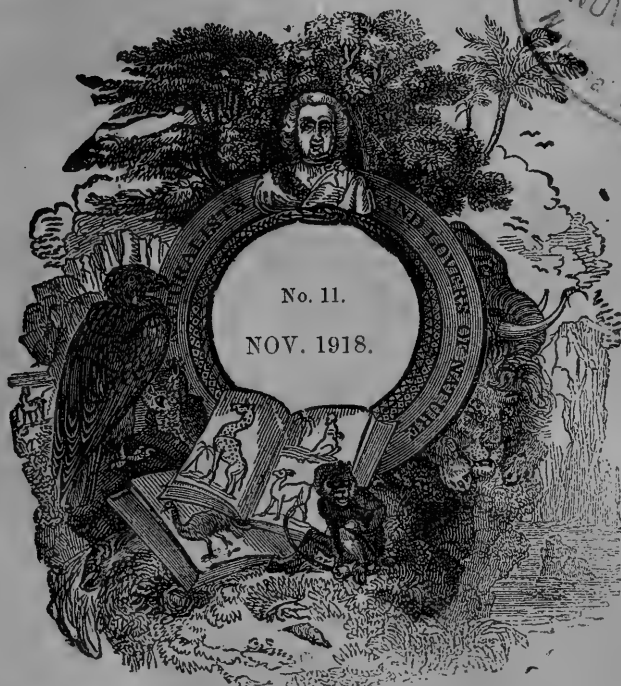
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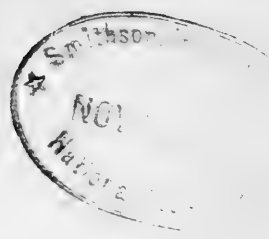
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No. 11. NOVEMBER 1918.

XXXVI.—*Descriptions of New Pyralidæ of the Subfamily*
Pyraustinae. By Sir GEORGE F. HAMPSON, Bart., F.Z.S.,
&c.

[Concluded from p. 196.]

Genus *PIONEA* will stand as

	Type.
<i>Hapalia</i> , Hübn. Verz. p. 355 (1827)	<i>fulvalis</i> .

(1*h*) *Hapalia bifossata*, sp. n.

Antennæ of male laminate with ridge of scales above ; fore wing with depressed streaks beyond the cell above and below vein 6.

♂. Head and thorax pale red-brown ; abdomen whitish with diffused brown bands except at base leaving whitish segmental lines ; frons with white lines at sides ; palpi red-brown, white at base ; pectus, legs, and ventral surface of abdomen white tinged with ochreous brown, the fore tibiæ with dark brown band at extremity. Fore wing whitish tinged with red-brown, the costal and terminal areas broadly suffused with red-brown and the latter irrorated with darker brown, the costal edge dark brown to the postmedial line, then whitish with two minute dark spots on it ; antemedial line red-brown, oblique to submedian fold and incurved below vein 1 ; a brown point in the cell towards extremity and obliquely curved discoidal striga ; the depressed streaks beyond the cell whitish ; postmedial line dark brown, slightly incurved below costa, then excurved and minutely waved to below vein 3 where it is retracted to below end of cell, excurved below submedian fold ; a terminal series of minute dark spots, rather bar-shaped below vein 4 ; cilia dark brown, chequered with whitish at

tips. Hind wing white, the inner area tinged with red-brown, the terminal area suffused with red-brown to vein 2; a blackish point at lower angle of cell; postmedial line brown, excurved from discal fold to vein 2 where it terminates; a terminal series of minute dark spots to vein 1; cilia red-brown with white tips to submedian fold, then wholly white; the underside white with the costal area tinged with red-brown, black points at the angles of cell, the postmedial line black, punctiform, and extending to vein 1.

Hab. PERU, Carabaya, Oconeque (*Ockenden*), 1 ♂ type. *Exp.* 20 mm.

(1 i) *Hapalia lobibasalis*, sp. n.

Antennæ of male laminate with ridge of scales above; hind wing with the costa lobed near base.

♂. Head and thorax whitish suffused with red-brown; abdomen white slightly suffused with red-brown; palpi dark red-brown, white in front to extremity of 2nd joint; pectus, legs, and ventral surface of abdomen white slightly suffused with red-brown. Fore wing whitish suffused with red-brown, the costa darker brown; a faint oblique sinuous brown antemedial line; postmedial line brown, waved, excurved from vein 6 to 4, then oblique; a terminal series of minute black-brown spots to vein 2; cilia with a brown line at middle. Hind wing white tinged with red-brown; a terminal series of minute black-brown spots to vein 2; the underside with indistinct curved brown postmedial line from costa to vein 2.

Hab. ECUADOR, Zamora (*Abbé Gaujon*), 1 ♂ type. *Exp.* 20 mm.

(4 a) *Hapalia magnifovealis*, sp. n.

♂. Head, thorax, and abdomen orange-yellow; frons with white lines at sides; palpi white at base; pectus, legs, and ventral surface of abdomen white tinged with yellow, the fore tibiæ orange-yellow in front. Fore wing orange-yellow, the costal area more fulvous orange, the terminal area rather narrowly suffused with red-brown and glossed with silvery blue from below apex to submedian fold; antemedial line indistinct, orange, very oblique; the fovea beyond the cell large, white with a brownish white boss in it; postmedial line orange, excurved to vein 3, then retracted to below end of cell and oblique to inner margin; a punctiform red-brown terminal line from below apex to submedian fold slightly defined on inner side by orange; cilia fulvous orange, whitish at tips. Hind wing orange-yellow, the cell and costal area to near apex and the inner area white; an orange postmedial line from vein 5 to submedian fold; the terminal area narrowly suffused with red-brown and glossed with silvery blue from below apex to

vein 2; a dark brown terminal line from apex to submedian fold; cilia orange-yellow with a deeper orange line through them and some whitish at tips to submedian fold, then white tinged with yellow.

Hab. PERU, Yahuar Mayo, 1 ♂ type. *Exp.* 18 mm.

(15 b) *Hapalia endotrichialis*, sp. n.

♂. Head, thorax, and abdomen orange-yellow; palpi with the basal joint white; pectus and ventral surface of abdomen at base with some white. Fore wing orange-yellow; a faint brownish antemedial line, oblique to median nervure, then erect; minute reddish brown spots in the cell towards extremity and on discocellulars; postmedial line reddish brown, excurved and slightly waved to below vein 3, then retracted to below end of cell and waved to inner margin; a fine dark brown terminal line. Hind wing orange-yellow; postmedial line brown, arising at vein 6, oblique to vein 2, then slightly incurved and ending at submedian fold; a fine dark brown terminal line except towards tornus.

Hab. FORMOSA (Wileman), 1 ♂ type. *Exp.* 28 mm.

(24 a) *Hapalia glaucostigmalis*, sp. n.

♀. Head and thorax rufous; abdomen greyish suffused with red-brown; antennæ red-brown; palpi red-brown, white below to near extremity of 2nd joint; pectus, legs, and ventral surface of abdomen white mixed with red-brown, the fore legs red-brown, white on inner side. Fore wing rufous, the inner area paler; small obliquely placed dark brown spots in the cell, in submedian fold, and on inner margin; a small grey-white spot in middle of cell and discoidal lunule defined by dark brown; postmedial line dark brown, excurved from below costa to vein 4, then oblique and slightly sinuous; a brown subterminal shade. Hind wing ochreous white; an indistinct curved brown postmedial line; a slight terminal brown shade from apex to vein 2; cilia whitish.

Hab. COLOMBIA, Rio Derg, 1 ♀ type. *Exp.* 24 mm.

(34 b) *Hapalia nigristriatalis*, sp. n.

♂. Head, thorax, and abdomen white tinged with red-brown, the last darker towards extremity; palpi suffused with red-brown below, white above; pectus, legs, and ventral surface of abdomen white tinged with red-brown. Fore wing white tinged with red-brown, the inner half whiter to beyond middle, the terminal area broadly suffused with red-brown; a rather diffused red-brown fascia through the cell; the veins beyond the cell slightly streaked with red-brown and veins 7, 6 streaked with black defined below by white streaks towards termen; five black points on terminal

part of costa which is white; some blackish scales on lower disco-cellular; a terminal series of minute blackish points on an ochreous white line; cilia dark brown, chequered with white at tips. Hind wing white, the termen narrowly suffused with red-brown to submedian fold; a terminal series of black points to vein 2; cilia white.

Hab. COLOMBIA, San Antonio (*Palmer*), 1 ♂ type. *Exp.* 22 mm.

(35 a) *Hapalia tristigmalis*, sp. n.

Head white tinged with cupreous brown; thorax pale cupreous brown; abdomen whitish banded with dark brown except towards base; antennæ dark brown ringed with white; frons with white lines at sides; palpi dark brown, white in front towards base and with some white at tips; pectus, legs, and ventral surface of abdomen white mixed with some black-brown, the fore tibiæ black-brown, the tarsi ringed with black. Fore wing whitish suffused with cupreous brown with a slight purplish gloss, the costal edge black with alternating white marks towards apex; a curved black antemedial line, defined on inner side by white and with a small triangular creamy white spot beyond it below the costa; a small conical creamy white spot defined by black except above in upper part of cell towards extremity; a sinuous black line defined on outer side by white from lower angle of cell to inner margin; a creamy white postmedial patch defined by black from costa to vein 5, its outer edge angled outwards at vein 6, then reduced to a bar; cilia creamy white, chequered with brown at base and with brown line at middle. Hind wing white faintly tinged with brown; slight dark spots in upper part of cell towards extremity and at upper angle; a faint brown postmedial line, incurved between discal and submedian folds; the terminal area suffused with pale purplish brown except towards tornus; cilia chequered with brown at base and with brown line at middle to vein 2; the underside with black spots in the cell near base and before and at end of cell, a postmedial series of black spots, incurved at discal fold and ex-curved above inner margin.

Hab. COLOMBIA, Sierra del Libane (*H. H. Smith*), 4 ♂, 2 ♀ type, Bonda (*H. H. Smith*), 1 ♂, 1 ♀. *Exp.* 18 mm.

(36 a) *Hapalia distictalis*, sp. n.

♀. Head, thorax, and abdomen dark cupreous brown; palpi white below to near tips; pectus, legs, and base of ventral surface of abdomen with some white, the tarsi creamy white. Fore wing dark cupreous brown; a faint oblique dark antemedial line; a small triangular creamy white spot defined by blackish except above in upper part of cell towards extremity; a faint sinuous dark line from lower angle of cell to inner margin; a postmedial

creamy white bar defined by blackish between veins 8 and 4, its outer edge slightly angled outwards at veins 6 and 5; cilia white at tips with some brown scales mixed. Hind wing dark cupreous brown; a faint dark discoidal bar; a faint slightly sinuous dark postmedial line from vein 4 to tornus; cilia white at tips; the underside with waved dark postmedial line, incurved at discal fold; both wings with white line at base of cilia.

Hab. COLOMBIA, Don Amo (*H. H. Smith*), 1 ♀ type, Bonda (*H. H. Smith*), 1 ♀. *Exp.* 20–22 mm.

(36 d) *Hapalia flavipartalis*, sp. n.

♂. Head and thorax yellow mixed with red-brown, the frons whitish, the antennæ whitish tinged with brown; palpi red-brown, white below towards base and with some whitish at tips; abdomen white mixed with red-brown; pectus, legs, and ventral surface of abdomen white, the fore tibiæ yellowish, the mid femora with minute brown spot at extremity. Fore wing with the basal half orange-yellow, the base suffused with red-brown, the terminal area red-brown; an oblique sinuous brown antemedial line; a brown annulus in middle of cell; a curved brown medial line confluent with the inner side of a reddish brown discoidal spot defined by dark brown and with dark brown striga in centre, the spot confluent on outer side with the brown terminal area; a conical orange-yellow postmedial patch from costa to vein 5, defined by dark brown and its inner edge confluent with the yellow basal area at costa; cilia white at tips from below apex to vein 4 and with some white at submedian interspace. Hind wing white, tinged with red-brown except the cell and costal area to beyond middle; the cilia white; the underside white, the terminal area tinged with brown to vein 2.

Hab. COLOMBIA, Choko, R. Siato, 1 ♂ type. *Exp.* 20 mm.

(38 b) *Hapalia umbriferalis*, sp. n.

♂. Head and thorax rufous, some white on vertex of head and on metathorax behind; abdomen dark red-brown with white segmental lines; palpi with some white at base; pectus, legs, and ventral surface of abdomen white mixed with rufous, the femora, tibiæ, and tarsi banded with black. Fore wing rufous suffused with dark brown, the costal area bright rufous except towards base, with three small black spots on the costa towards apex; antemedial line black-brown, angled outwards below costa, excurved below the cell and angled inwards above inner margin, defined on inner side by whitish below the cell; a small black annulus in upper part of middle of cell and discoidal figure-of-eight shaped mark, its upper and lower parts filled in with rufous, the rufous from costa extending into the cell before it; postmedial line black-brown defined

on outer side by whitish, strong and obliquely downcurved to vein 6, then excurved and minutely dentate to vein 2 where it is retracted to below angle of cell and bent outwards below submedian fold; a terminal series of minute black spots with whitish striæ between them; cilia dark red-brown, whitish at tips. Hind wing red-brown, rather darker at termen on which there is a series of minute blackish points; cilia white at tips; the underside pale rufous slightly irrorated with dark brown, a minute black spot in middle of cell and small spots at the angles, postmedial line black, maculate, excurved to below vein 3, then retracted and ending in a small spot below vein 2, a terminal series of black points to vein 2 and some dark brown at submedian fold.

Hab. PERU, San Domingo (*Ockenden*), 1 ♂ type. *Exp.* 22 mm.

(50 b) *Hapalia conisanalis*, sp. n.

♀. Head, thorax, and abdomen red-brown mixed with some greyish, the last with white segmental lines except towards base; frons with white lines at sides; palpi rufous, white at base; pectus, legs, and ventral surface of abdomen white tinged with red-brown. Fore wing whitish suffused with red-brown and thickly irrorated with dark brown, the terminal area rather more strongly suffused with red-brown; antemedial line rather diffused, brown, slightly waved; a minute brown spot in upper part of cell towards extremity and discoidal striga; a brown shade beyond the cell from costa to vein 2; postmedial line brown, minutely waved, excurved from below costa to vein 3, then retracted to below end of cell; a rather punctiform dark brown terminal line to submedian fold; cilia with a brown line through them, the tips whitish. Hind wing whitish suffused with red-brown and irrorated with dark brown; postmedial line indistinct, brown, slightly excurved from discal fold to vein 2 where it terminates; a rather punctiform dark terminal line to 2; cilia with a brownish line near base and the tips whitish to vein 2, then wholly whitish.

Hab. BR. C. AFRICA, Shiré Valley, Mwanza R. (*Neave*), 1 ♀ type, Mt. Mlangé (*Neave*), 1 ♀. *Exp.* 20 mm.

(101 a) *Hapalia lunilinealis*, sp. n.

♂. Head, thorax, and abdomen rufous, the genital tufts white; palpi below towards base and pectus in front white; tarsi white tinged with rufous. Fore wing rufous; antemedial line indistinct, brown, oblique, and slightly sinuous to vein 1, then incurved; a slight dark discoidal lunule; postmedial line formed by minute dark lunules, excurved from below costa to below vein 3, then retracted to below end of cell and erect to inner margin; a brown terminal line; cilia whitish tinged with rufous and with brown line near base. Hind wing whitish tinged with rufous; a curved

postmedial series of brown points on veins 5 to 2; a red-brown terminal line and line near base of cilia to vein 2.

Hab. ECUADOR, Zamora (*Abbé Gaujon*), 6 ♂ type. *Exp.* 28 mm.

(104e) *Hapalia rubritactalis*, sp. n.

♂. Head, thorax, and abdomen ochreous yellow tinged with rufous; palpi rufous, the basal joint white; pectus, legs, and ventral surface of abdomen white, the fore legs tinged with rufous; a faint diffused brownish antemedial line from subcostal nervure to inner margin; a small brownish spot in upper part of cell towards extremity and discoidal bar; postmedial line indistinct, diffused, brownish, excurved to vein 3, then retracted to below angle of cell and erect to inner margin, slightly defined on outer side by yellow; the costal area yellower towards apex. Hind wing ochreous yellow suffused with rufous, the inner margin whitish; postmedial line brownish defined on outer side by diffused yellow, erect to vein 2 towards termen, then retracted and again erect to termen above tornus; the terminal area suffused with rufous to vein 1, leaving some yellow on termen; cilia white.

Hab. "GERM. E. AFRICA," Ruaha R., Kilossa Rd. (*Neave*), 1 ♂ type. *Exp.* 20 mm.

(127b) *Hapalia carbonifusalis*, sp. n.

Head fuscous brown mixed with some ochreous; thorax fuscous brown; abdomen greyish suffused with fuscous brown; antennæ fuscous brown; palpi black-brown with some white below; pectus, legs, and ventral surface of abdomen grey suffused with fuscous brown, the fore tibiæ with black band at extremity. Fore wing fuscous brown mixed with grey-white; antemedial line blackish, oblique to median nervure, then erect; a slight white discoidal lunule defined by fuscous brown; postmedial line rather diffused blackish, slightly excurved at vein 7, and bent outwards between veins 5 and 3, then retracted to below end of cell and erect to inner margin; a blackish terminal line; cilia chequered with blackish at tips. Hind wing fuscous brown tinged with grey.

Hab. BR. C. AFRICA, Mt. Mlanje (*Neave*), 3 ♂, 3 ♀ type. *Exp.* 16-20 mm.

(127d) *Hapalia conistolalis*, sp. n.

♂. Head, thorax, and abdomen dark brown mixed with grey-white; antennæ dark brown; palpi black-brown; fore tibiæ at extremity and the tarsi banded black and white. Fore wing thickly irrorated with dark brown and grey-white; antemedial line black, slightly waved, oblique to submedian fold, then erect; a small rather diffused blackish spot in middle of cell; a small white

discoidal lunule irrorated with brown and defined at sides by black; postmedial line black, excurved at vein 7 and between veins 5 and 3, then retracted to below angle of cell and excurved below submedian fold; a terminal series of small black spots; cilia white mixed with brown. Hind wing grey-brown irrorated with fuscous; a dark terminal line except towards tornus; cilia white mixed with brown and with brown line at middle.

Hab. N. NIGERIA, Zingeru (*Simpson*), 1 ♂ type, Minna (*Macfie*), 1 ♂. *Exp.* 20 mm.

(127 e) *Hapalia pulverulenta*, sp. n.

♂. Head and thorax reddish brown mixed with grey-white; abdomen whitish tinged with red-brown; frons with white lines at sides; palpi red-brown, white at base; pectus, legs, and ventral surface of abdomen white, the fore legs suffused with red-brown. Fore wing reddish brown mixed with some white; a brown antemedial line in submedian interspace, angled outwards to a slight spot at submedian fold; slight brown spots at middle of cell and on discocellulars; postmedial line formed by small brown spots, defined on outer side by slight white marks and with some white before it at discal fold, excurved from discal fold to vein 3, then incurved; a terminal series of minute blackish spots. Hind wing pale reddish brown; a terminal series of black points to vein 2; cilia white tinged with red-brown. Underside of fore wing grey-brown, the costal area white to near apex; hind wing white.

Hab. CEYLON, Ambalangoda (*Mackwood, Green, Pole*), 3 ♂ type. *Exp.* 20–22 mm.

(128 a) *Hapalia poliostolalis*, sp. n.

♀. Head, thorax, and abdomen grey-brown with a leaden gloss, the last with white segmental lines; palpi white below; pectus, legs, and ventral surface of abdomen white tinged with brown. Fore wing grey-brown with a leaden gloss; a faint erect brown antemedial line; a faint dark discoidal bar; postmedial line rather diffused dark brown, very slightly waved, excurved from costa to below vein 3, then retracted to below angle of cell and erect to inner margin; cilia white tinged with brown, with dark line near base and slight spots near tips. Hind wing grey-brown with a leaden gloss, the cilia white with a dark line near base; the underside white mixed with brown, obliquely placed small black spots at the angles of cell, a curved punctiform dark postmedial line, and terminal series of black points.

Hab. FORMOSA, Kanshirei (*Wileman*), 1 ♀ type. *Exp.* 16 mm.

(1 a) *Pyrausta pectinalis*, sp. n.

Antennæ of male bipectinate with long fine branches to two-thirds length.

♂. Head and thorax pale red-brown; abdomen whitish suffused with red-brown; antennæ ringed with black towards base; palpi black-brown, white below to near extremity of 2nd joint; pectus, legs, and ventral surface of abdomen white, the fore coxæ dark brown towards base, the femora and tibiæ suffused with red-brown. Fore wing glossy red-brown; a faint dark discoidal bar; cilia with pale line at base and some whitish at tips. Hind wing glossy red-brown; a faint dark mark at upper angle of cell; cilia with some whitish at tips; the underside whitish tinged with red-brown, a faint rather diffused brown postmedial line from costa to vein 4.

Hab. PERU, Chanchamayo, 1 ♂ type. *Exp.* 26 mm.

(31 b) *Pyrausta fulviflavalis*, sp. n.

♀. Head whitish tinged with fulvous; thorax fulvous; abdomen whitish suffused with fulvous; palpi rufous, white below; throat white; pectus, legs, and ventral surface of abdomen pale rufous, the mid tibiæ on outer side and all the tarsi white. Fore wing fulvous, the costal edge brown to middle, then white; antemedial line indistinct, brown, oblique and waved to above vein 1 and angled inwards above inner margin; a brown point in upper part of middle of cell and curved discoidal striga; a diffused brown spot beyond lower angle of cell; postmedial line brown, dentate, oblique to vein 5, then inwardly oblique and incurved above inner margin; cilia rufous. Hind wing semihyaline whitish tinged with orange-yellow, the terminal area orange-yellow to submedian fold, angled inwards at vein 2 to below end of cell; a curved series of slight red-brown lunules on veins 4, 3, 2; a red-brown terminal line and the cilia rufous from below apex to vein 2.

Hab. ARGENTINA, Puerto Aguirre (*Betton*), 1 ♀ type. *Exp.* 32 mm.

(38 a) *Pyrausta violascens*, sp. n.

♀. Head and tegulæ fulvous; thorax very pale purplish; abdomen white with a violaceous grey tinge; palpi rufous, white below towards base; pectus, legs, and ventral surface of abdomen white faintly tinged with brown. Fore wing very pale purplish, the costal area fulvous to beyond middle; a faint oblique brownish antemedial line; a small fulvous spot in the cell towards extremity and discoidal bar; a faint brownish postmedial line, excurved and slightly waved between veins 5 and 2, then retracted to below angle of cell and oblique to inner margin; cilia whitish. Hind wing very pale purplish, the inner area whitish; a faint brownish

postmedial line, excurved and slightly waved between veins 5 and 2, where it terminates; cilia whitish.

Hab. GOLD COAST, Kumasi (*Sanders*), 1 ♀ type. *Exp.* 28 mm.

(55 a) *Pyrausta fulvilinealis*, sp. n.

♂. Head and thorax white mixed with some fulvous; abdomen white; antennæ pale fulvous; frons with black bars at sides; palpi fulvous mixed with some blackish, white below towards base; pectus, legs, and ventral surface of abdomen white, the fore femora red-brown above, the tibiæ black on inner side and the tarsi ringed with black. Fore wing creamy white, the costal area tinged with fulvous and the costal edge black-brown to end of cell; antemedial line fulvous, oblique, slightly excurved below costa; a small fulvous spot in the cell towards extremity and discoidal lunule defined by fulvous; postmedial line fulvous, interrupted, angled outwards below costa, then incurved to vein 5 where it is interrupted, oblique to vein 2, then represented by a bar below angle of cell and oblique line from vein 2 to inner margin; subterminal line fulvous, rather interrupted, oblique to vein 5, excurved between veins 5 and 4, and angled inwards at vein 2 to near the postmedial line; the costa fulvous towards apex; a fine fulvous terminal line. Hind wing creamy white; a fulvous discoidal bar; postmedial line fulvous, slightly bent outwards between veins 5 and 2, then retracted and obsolete to lower angle of cell, then oblique to inner margin; subterminal line fulvous, slightly excurved between veins 6 and 2 and ending at tornus; a fine fulvous terminal line and slight line near base of cilia.

Hab. UGANDA, Mbale-Kumi Rd. (*Neave*), 1 ♂ type. *Exp.* 32 mm.

(58 a) *Pyrausta distictalis*, sp. n.

♂. Head and thorax whitish suffused with fulvous; abdomen creamy white faintly tinged with rufous; pectus, legs, and ventral surface of abdomen creamy white, the fore legs tinged with rufous, the femora, tibiæ, and base of tarsi blackish above. Fore wing very pale yellow, the base suffused with fulvous, the costal edge blackish; a minute black spot in the cell towards extremity and another at lower angle. Hind wing uniform very pale yellow. Underside of fore wing tinged with brown except on inner area.

Hab. BR. C. AFRICA, Mt. Mlanje (*Neave*), 2 ♂ type. *Exp.* 24 mm.

(61 c) *Pyrausta leucoplacalis*, sp. n.

♂. Head and thorax cupreous brown with some white on meta-thorax; abdomen white indistinctly banded with cupreous brown; antennæ whitish tinged with cupreous brown; sides of frons and

palpi black-brown, the latter white below; pectus, legs, and ventral surface of abdomen white, the fore femora and tibiæ suffused with cupreous brown and the mid tibiæ with cupreous brown spots at extremity. Fore wing cupreous brown, an ochreous white fascia below costa from the antemedial to beyond the postmedial line; antemedial line dark brown defined on inner side by ochreous white, arising at median nervure and slightly angled outwards above inner margin, an ochreous white patch beyond it at inner margin; a small semihyaline white spot in middle of cell and discoidal spot defined by dark brown except above where it is confluent with the subcostal fascia; postmedial line dark brown, waved and defined on outer side by a waved ochreous white band, with a semihyaline white patch before it beyond the cell and spots below veins 4, 3, 2, excurved from costa to vein 4, then oblique; a narrow terminal ochreous white band and a terminal series of small brown spots to vein 2; cilia white. Hind wing semihyaline white to the postmedial line, then ochreous white; small black-brown subbasal spots below the cell and above inner margin; a black discoidal bar; postmedial line black-brown, arising below costa, curved and waved between veins 5 and 2, where it is retracted, then sinuous to inner margin; a wedge-shaped cupreous brown subterminal patch with waved edges from below costa to vein 3, then a rather diffused interrupted sinuous line; a terminal series of small brown spots to vein 2; cilia white.

Hab. COLOMBIA, Sierra del Libane (*H. H. Smith*), 2 ♂ type.
Exp. 26 mm.

(103 b) *Pyrausta xanthyalinalis*, sp. n.

♀. Head and thorax pale yellow tinged with rufous; abdomen pale yellow; frons with blackish bars at sides; palpi black-brown above and white at base; pectus, legs, and ventral surface of abdomen white, the legs tinged with yellow, the fore legs with dark brown mark at femoro-tibial joint. Fore wing pale yellow, thinly scaled, the costal area tinged with rufous and the costal edge dark brown to the postmedial line; antemedial line brown, slightly curved; a dark brown discoidal lunule; postmedial line dark brown, curved inwards and obsolescent between veins 5 and 2 and slightly excurved above inner margin; a terminal series of brown striæ from apex to vein 4. Hind wing pale yellow, thinly scaled; a brown discoidal striga; postmedial line brown, curved inwards and obsolescent between veins 5 and 2.

Hab. ECUADOR, R. Pastaza, El Topo (*Palmer*), 3 ♂ type.
Exp. 24 mm.

(106 b) *Pyrausta microdentalis*, sp. n.

♀. Head and thorax whitish tinged with red-brown; abdomen white faintly tinged with brown; palpi red-brown, white below;

pectus, legs, and ventral surface of abdomen white, the fore legs and mid femora streaked with brown. Fore wing whitish suffused with pale reddish brown and slightly irrorated with fuscous; a curved blackish antemedial line; a black discoidal bar; postmedial line blackish, curved and minutely dentate to vein 2 where it is retracted to below end of cell and oblique to inner margin; a faint rather diffused dentate brown subterminal line; a fine black terminal line; cilia whitish at tips. Hind wing whitish suffused with pale reddish brown and irrorated with fuscous, the inner margin white; an oblique blackish discoidal bar; postmedial line rather diffused blackish, waved to vein 2, then retracted to below angle of cell and ending at tornus; a blackish subterminal shade with slightly waved outer edge to vein 2, then oblique; a fine black terminal line; cilia with dark line near base, the tips white.

Hab. BR. E. AFRICA, N. Kavirondo, Maramas Distr., Ilala (*Neave*), 1 ♀ type. *Exp.* 20 mm.

(107 b) *Pyrausta pulvereiumbralis*, sp. n.

♂. Head and thorax ochreous tinged with rufous; abdomen whitish suffused with red-brown and with white segmental lines towards extremity, the anal tuft tinged with rufous; palpi white below towards base; pectus, legs, and ventral surface of abdomen white slightly tinged with brown. Fore wing ochreous tinged with rufous, irrorated with brown from before the antemedial to beyond the postmedial line except on costal area, the medial area whitish except towards costa; antemedial line fulvous yellow with a brownish line on it, curved; a small brown spot defined by fulvous yellow in upper part of cell towards extremity and brown discoidal bar defined by fulvous yellow; an oblique brown shade from beyond upper angle of cell to inner margin beyond the postmedial line, which is fulvous yellow with a brownish line on it, excurved from vein 7 to 5, then rather oblique to vein 3, then bent inwards to lower angle of cell, then again rather oblique and bent outwards to inner margin, a brown shade with waved outer edge beyond it from below costa to vein 3; a curved rather diffused fulvous yellow subterminal line, arising below the costa; cilia white with a faint ochreous brown line at middle. Hind wing white; a brownish postmedial line, bent inwards at vein 2, then oblique to tornus; a brownish subterminal line.

Hab. ABYSSINIA, Diré Daroua (*Kristensen*), 1 ♂ type. *Exp.* 24 mm.

(107 e) *Pyrausta fulvitinctalis*, sp. n.

♀. Head and thorax fulvous; abdomen red-brown with fine white segmental lines on medial segments; antennæ dark brown; frons with white lines at sides; palpi yellow with a fulvous tinge; pectus, legs, and ventral surface of abdomen white tinged with

rufous. Fore wing red-brown, suffused with fulvous to middle and on costal area to apex; a faint dark antemedial line, oblique to submedian fold, then inwardly oblique; postmedial line dark, oblique towards costa, then excurved and minutely waved to vein 3, slightly angled inwards at vein 2 and erect to inner margin; a fine dark brown terminal line; cilia with a fine pale line at base followed by a brown line. Hind wing red-brown; an indistinct curved dark postmedial line; a dark brown terminal line; cilia with a fine pale line at base followed by a brown line; the underside paler, the costal area ochreous white to the postmedial line.

Hab. ECUADOR, Zamora (*Abbé Gaujon*), 1 ♀ type. *Exp.* 20 mm.

(108 b) *Pyrausta xanthocephalis*, sp. n.

♂. Head yellow tinged with rufous; antennæ, thorax, and abdomen glossy fuscous brown; palpi dark brown, yellowish above and white below to near extremity of 2nd joint; pectus, legs, and ventral surface of abdomen white tinged with brown. Fore wing glossy fuscous brown slightly irrorated with whitish; a diffused whitish spot in end of cell; postmedial line whitish, somewhat dilated at costa, incurved at discal fold, excurved to vein 3, then retracted to below angle of cell and excurved below submedian fold; a terminal series of slight black points and fine white line at base of cilia. Hind wing pale brown with a slight cupreous tinge; cilia with a fine white line at base followed by a brown line, the tips with some whitish.

Hab. MEXICO, Guerrero (*H. H. Smith*), 2 ♂ type, Godman-Salvin Coll., Guadalajara (*Goldsmith*), 1 ♂. *Exp.* 20 mm.

(113 b) *Pyrausta infuscalis*, sp. n.

♀. Head, thorax, and abdomen dark reddish brown; palpi dark brown, white below to near extremity of 2nd joint; pectus, legs, and ventral surface of abdomen white tinged with brown. Fore wing dark reddish brown slightly irrorated with whitish; a faint dark antemedial line, oblique towards costa and defined on outer side by whitish below the cell; postmedial line indistinct, rather diffused dark brown slightly defined on outer side by whitish, somewhat angled outwards below costa, incurved at discal fold, excurved to vein 2, then retracted to below angle of cell and erect to inner margin; a terminal series of small rather triangular blackish spots; cilia whitish mixed with brown. Hind wing pale reddish brown, the costal area whitish to beyond middle; cilia whitish with a brown line near base; the underside whitish mixed with brown, a dark postmedial line excurved below vein 7 and between veins 5 and 2.

Hab. SIKHIM (*Möller*), 1 ♀ type. *Exp.* 20 mm

(139 b) *Pyrausta auricinctalis*, sp. n.

♂. Head and tegulæ orange-yellow, the latter with some dark brown dorsally; thorax dark brown mixed with yellow; abdomen dark purplish brown, the two terminal segments orange-yellow, the genital tufts paler yellow; antennæ brown, orange-yellow towards base; pectus and legs yellowish tinged with brown. Fore wing dark purple-brown; the base orange-yellow; the costal edge orange-yellow to a medial orange-yellow band from costa to above vein 1, rounded below, the costa beyond it orange-yellow; an orange-yellow terminal band with curved inner edge; cilia orange-yellow at base, whitish at tips. Hind wing dark purplish brown; an orange-yellow terminal band, the inner edge slightly incurved at submedian fold; cilia orange-yellow, whitish at tips.

Hab. BR. E. AFRICA, N. Kavirondo, Maramas Distr., Ilala (Neave), 1 ♂ type. *Exp.* 18 mm.

(8 a) *Pegostoma subterminalis*, sp. n.

♂. Head, thorax, and abdomen white mixed with reddish brown; antennæ brown; palpi dark brown, white below; pectus, legs, and ventral surface of abdomen white mixed with dark brown. Fore wing white, the basal area and costal area to apex tinged with red-brown; a red-brown subterminal band, its inner edge incurved below vein 5 and slightly angled outwards above vein 1; cilia pale red-brown. Hind wing pale red-brown. Underside white suffused with red-brown.

Hab. ORANGE R. COLONY, Bloemfontein (*Eckersley*), 1 ♂ type. *Exp.* 16 mm.

(4 a) *Noctuelia anartalis*, sp. n.

♀. Head, thorax, and abdomen dark brown mixed with some white; antennæ dark brown; palpi dark brown, the basal joint white; pectus, legs, and ventral surface of abdomen white mixed with dark brown. Fore wing red-brown mixed with white and slightly irrorated with dark brown; an oblique black-brown line defined on inner side by white from upper part of cell towards extremity to inner margin; some diffused blackish beyond upper angle of cell; postmedial line white defined on inner side by a fine slightly dentate black-brown line, incurved below vein 4 and slightly angled outwards below submedian fold; a diffused sinuous whitish subterminal band indented by a wedge-shaped dark mark from termen above vein 1; cilia white with a brown line near base and some brown at tips. Hind wing orange-yellow, the costal area white; some dark brown irroration along vein 1; a narrow red-brown terminal band, ending in a point at submedian fold, its inner edge slightly waved; cilia brown, white at tips. Underside

of fore wing white, tinged with yellow on disk, the costal area irrorated with red-brown; hind wing orange-yellow, the costal area white, irrorated with red-brown except towards base, the terminal band formed by red-brown irroration.

Hab. E. TURKESTAN (*Avinoff*), 1 ♀ type. *Exp.* 22 mm.

(7 a) *Noctuelia josialis*, sp. n.

♂. Head and tegulae orange-yellow, the latter with black-brown patches at tips glossed with blue, with orange-yellow stripes at sides and the patagia with some orange-yellow scales; abdomen black-brown with a cupreous gloss and orange-yellow subdorsal stripes, the genital tufts white; antennae black: frons with black patch; palpi black, the basal joint and base of 2nd joint yellow; femora whitish tinged with brown; ventral surface of abdomen with white stripe except at extremity. Fore wing black-brown with a cupreous gloss; an orange-yellow fascia along median nervure to near termen where its extremity is rounded; an orange-yellow streak on inner margin. Hind wing black-brown with a cupreous gloss; a broad orange-yellow stripe in and below the cell to near termen, extending to inner margin at base and narrowing somewhat with its lower edge oblique beyond the cell.

Hab. VENEZUELA, Esteban Valley, Las Quiguas, 1 ♂ type. *Exp.* 30 millim.

XXXVII.—On the Synonymy of some European Diplopods (*Myriapoda*), with Special Reference to Three Leachian Species. By RICHARD S. BAGNALL, F.L.S.

ONE of the drawbacks to students of British Myriapods undoubtedly lies in the unsatisfactory state of the nomenclature. When one remembers that, amongst the Diplopods, there are so many instances of two (or more) species being so closely related as to be practically indistinguishable, except by a dissection and study of the male, one at once realizes how difficult it must be for a discoverer of a species so closely allied to one already known to decide which of the two was the one described by an older naturalist at a time when present-day methods were not used.

A case in point: *Brachyiulus pusillus*, a graceful little Julid with a pair of yellowish stripes down the back, was described by Leach from Edinburgh and London more than a hundred years ago. In recent years Verhoeff showed that there were two species, externally alike but abundantly

distinct in the structure of the male gonopods etc., describing one of them as new under the name of *Brachyiulus littoralis*. The dissection of male examples, however, from an abundance of British material proves that all our examples are referable to Verhoeff's species. Surely, by deduction, one must refer the British material to Leach's species, and so sink Verhoeff's name as a synonym. And, further, another name must be found for the *pusillus* of Verhoeff (non Leach).

The present memoir is an attempt to show my deductions as to the true synonymy of three of Leach's species, from which it will be seen that new names will have to be found for *Craspedosoma rawlini*, Verhoeff (non Leach), and *Brachyiulus pusillus*, Verhoeff (non Leach). As existing names (now sunk as synonyms) may be found applicable, I leave this question to more capable hands. I have, however, suggested a new name for *Craspedosoma simile*, Attems (non Verhoeff), the issue in this instance not being complicated by old synonymy.

Of four of Leach's memoirs on Myriapods containing practically the same subject-matter, I have perused the following :—

Leach, W. E. 1814-15. "A Tabular View of the External Characters of Four Classes of Animals, which Linné arranged under Insecta ; with the Distribution of the Genera composing Three of these Classes into Orders &c., and Descriptions of several new Genera and Species." In Trans. Linn. Soc. Lond. vol. xi. (1815) pp. 306-400 (Class II. Myriapoda, pp. 376-386).

Leach, W. E. 1817. "The Characters of the Genera of the Class Myriapoda, with Descriptions of some Species." In the 'Zoological Miscellany,' iii. pp. 36-45 (with 10 plates).

The following extract is from the first of these references :—

[p. 379]

"Spec. 7. *Julus pusillus*.

"J. Segmento ultimo submucranato, corpore cinerascens nigro aut fusco-brunneo lineis duabus rufescentibus.

"Long. Corp. 5 ad 6 lin.

"Habitat prope Edinburgum sub lapidibus ; in Battersea fields, Londinum prope, inter graninum radices.

"Copulatione observavi.

[p. 380]

"*β. Corpus rufescens lateribus lineaque longitudinale dorsali fuscus brunneis.*

"*Dorsum lineis fortioribus exaratis, distantibus rectis sub-inaequalibus. Antennæ fuscae articulis dilutis. Pedes lutescentes.*

"Gen. 3. CRASPEDOSOMA.†

[Footnote] "† This genus was proposed by my much lamented friend Richard Rawlins, Esq., who discovered the first species.

"*Corpus lineare, depressum, segmentis lateraliter compressis, marginatis. Antennæ articulo secundo tertio brevior.*

"* *Segmentis lateribus medio prominulis.*

"Spec. 1. *Craspedosoma Rawlinsii.*

"*C. dorso fusco-brunneo lineis quatuor punctorum albidorum, ventre pedibusque rufescentibus.*

"*Long. Corp. 7 lin.*

"*Habitat inter muscos et sub lapidibus prope. Edinburgum vulgatissima. Detexit R. Rawlins cujus nomen gerit.*

"** *Segmentis lateribus postice productis.*

"Spec. 2. *Craspedosoma polydesmoides.*

"*C. dorso rufo griseo, ventre pallido, pedibus rufescentibus basi pallidis, angulo segmentorum postico setigero.*

"*Habitat in Daemoniâ prope Plymouth, sub lapidibus passim. Detexit Dom Montagu.*

"*Corpus rufo-griseum, pedibus pallidioribus. Dorsum lineâ longitudinaliter impressum. Segmenta valdè prominentia angulo antico rotundato; postico retrorsum producto, setifero setâ conicâ albâ. Facies saturate rufo-grisea. Oculi atrii. Antennæ rufo-griseæ sub-pilosulæ. Venter pallidus, albidus. Pedes rufescentes, basi pallidi.*" [End of p. 380.]

Brachyiulus pusillus (Leach), non Verhoeff.

Syn. *Brachyiulus* (*Microbrachyiulus*) *littoralis*, Verhoeff.

Julus pusillus, Leach, 1814, Trans. Linn. Soc. Lond. xi. p. 379;
1817, Zool. Misc. iii. p. 35.

In 1917 I brought forward *B. (Microbrachyiulus) littoralis*, Verhoeff, as British on the strength of a large number of

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examples found at Ainsdale, near Southport, in April 1916, which were kindly identified by Brölemann. Since then I have taken examples of the same species in the Forth Area of Scotland, in the counties of Northumberland and Durham, both inland and on the coast, and in other localities, including the South Coast at Swanage. In every case expert examinations of the males were made by Mr. and Mrs. Brade-Birks, proving the species to be Verhoeff's *littoralis*.

Leach described *J. pusillus* from Edinburgh and London, and as I have secured material from one of these localities, and no British examples as yet dissected have been found to be referable to *pusillus* as diagnosed by Verhoeff, one is forced to the conclusion that when he demonstrated that there were two allied species, Verhoeff unfortunately gave the name *littoralis* to what was in reality Leach's species. I may have the opportunity this winter of going into the question of how far Verhoeff followed previous continental authors as regards *B. pusillus*; in any case, a new name must be found for *B. pusillus* of Verhoeff (non Leach), but as the names *boleti*, Am Stein (1857) and *stuxbergii*, Fanzago (1875), are given as synonyms of *pusillus* by Latzel, and might be referable to either species, I dare not go further in the matter just now.

Craspedosoma rawlinsii, Leach.

Syn. *Craspedosoma simile*, Verhoeff, non Attems.

Craspedosoma rawlinsii, Leach, 1814, Trans. Linn. Soc. Lond. xi. p. 380; 1817, Zool. Misc. iii. p. 36, pl. cxxxiv. figs. 1-5.

Craspedosoma rawlinsii, Samouelle, 1819, The Entomologist's Useful Compendium, p. 114.

Craspedosoma rawlinsii, var. *simile*, Verhoeff, 1891, Berl. Ent. Zeitsch. xxxvi. pp. 129-130.

Craspedosoma simile, Verhoeff, 1910, Sitzungsber. Ges. Naturf. Freunde, no. 1, pp. 19-62, figs.

Verhoeff first described his *simile* in 1891 as a variety of *rawlinsii*, but later raised it to specific rank, and in 1910 (reference above cited) he reviewed the genus *Craspedosoma* (pp. 30-55) and gave the tables of his subdivisions, species, and subspecies. That the species he regards as *rawlinsii* and *simile* are well characterized is distinctly demonstrated, but here again I contend that Verhoeff's species should be referred to the species Leach described.

In 1912 I sent Verhoeff specimens of *Craspedosoma* from Gibside, County Durham, which he returned as *C. simile* and

C. simile rhenanum, and as such I recorded them*. Examples identified by Ellingsen from Norway (a large series) were all referred to *simile* (and subspecies and varieties thereof) by Verhoeff (Zool. Anz. xxxix. pp. 499-511, May 1912), whilst the *C. rawlinsii* recorded from Holland in moles' nests by Father Heselhaus, S.J. (Tijdschrift voor Ent. lvi. 1913, p. 240), was later (*l. c.* lvii. 1914, p. 80) referred by Verhoeff to *simile*. It therefore seems that no examples of what he regards to be *rawlinsii* have been examined by Verhoeff from our faunal area, all so named being referred to *simile*, and until the reverse is proved I consider it distinctly advisable to regard Verhoeff's *simile* as a synonym of *rawlinsii*, Leach. In the meantime, it is to be hoped that more British examples may be secured for study.

Thus a new name is necessary for the *rawlinsii* of Verhoeff (non Leach), but as Latzel gives the names *marmoratum*, C. K. (1847), and *gibbosum*, Am Stein (1857), as synonyms, it would not be wise to suggest a new name without further research.

Craspedosoma leachi (nom. nov.), Bagn.

Syn. *Craspedosoma simile*, Attems (non Verhoeff), 1895, Sitz. k. Akad. Wiss. Wien, math.-naturw. Cl. civ. pp. 75-76.

A species allied to *mutabile*, Latz. When Attems described it he was aware of Verhoeff's var. *simile* of *rawlinsii*, but the raising of this form to specific rank rendered it necessary to give another name to Attems's species.

Polymicrodon polydesmoides (Leach).

Syn. *Polymicrodon latzeli* (Verhoeff).

Craspedosoma polydesmoides, Leach, 1814, Trans. Linn. Soc. Lond. xi. p. 380; 1817, Zool. Misc. iii. p. 36, pl. cxxxiv. figs. 6-9; Samouelle, 1819, The Entomologist's Useful Compendium, p. 114.

Atractosoma polydesmoides of later British authors.

Atractosoma latzeli, Verhoeff, 1891, Berl. Ent. Zeitsch. xxxvi. pp. 127-128, figs. 4-6.

Polymicrodon latzeli, Verhoeff, 1897, Berlin. Archiv. f. Naturgesch. i. pp. 129-138; 1912, Trans. Nat. Hist. Soc. Northumberland & Durham, n. s., iv. pp. 159-166, pl. x. figs. 4-7.

Also *Polymicrodon latzeli* of recent authors.

Atractosoma latzeli was described by Verhoeff in 1891 from the south of England, his description being based upon

* "Brief Records of *Chatechylene vesuviana*, Newp., and other Myriopods new to the British Fauna," The Zoologist, July 1912.

a solitary poorly preserved male example, and six years later the same author instituted the genus *Polymicrodon* for that species. In 1911 I submitted numerous examples of *P. latzeli* to Verhoeff from the north of England, who (1912) wrote at some length upon this material. Nowhere have I seen any attempt to show how *latzeli* differs from Leach's species *polydesmoides*, described somewhat over a hundred years ago (and figured) from South Devon, of which Samouelle says "inhabits Devonshire under stones. It is common all along the borders of Dartmoor and on the southern coast. It was once taken by Dr. Leach in the garden of the British Museum."

I have twice stated that there appeared to be two allied species, referring the commoner to *latzeli* and the rarer to *polydesmoides*; but in recent years I have made a closer study of the Diplopoda, and I am convinced that the so-regarded rarer species is in reality the later larval stages of *latzeli*.

Verhoeff states (1912, p. 165) that the occurrence of *P. latzeli* in the north of England is very noteworthy from the zoogeographical point of view "since this is the first time that a Craspedosomid of '*Atractosoma*-habit' has been recorded from the northern region affected by the Ice Age. This is by far the most northerly record for any such Craspedosomid." As a matter of fact, the species is not uncommon in Scotland and is one of the commonest Diplopods in the northern counties of England; it is probably as common in the midlands and the south, where I have collected it in North and South Devon, Bath, Oxford, Swanage, Portsmouth, Isle of Wight, and in the London district.

I see no grounds whatever for the retention of the name *latzeli*, which I consider must fall as a synonym of *polydesmoides*.

XXXVIII.—*New Lepidoptera in the Joicey Collection.*

By LOUIS B. PROUT, F.E.S.

Family Zygaenidæ.

1. *Caprima chrysosoma*.

♀.—31 mm.

Head and body orange-ochreous; antennal shaft blackish, with blue irroration (tips lost); tarsi blue-blackish on upper side; tibial spurs almost entirely atrophied.

Fore wing long and narrow, more recalling *Aphantcephala*, or even *Docleopsis*, than *Caprima*; SC^3 wanting, R^1 just stalked, DC acutely inangled; black, irrorated with blue; a small ochre-yellow patch at base, produced on the space between costal edge and vein C to a length of nearly 2 mm.; a narrow ochre-yellow streak from SC at 4 or 5 mm. from base, running very obliquely in direction of termen but not quite reaching SM^2 .

Hind wing black with blue irroration; abdominal margin ochre-yellow for a width of over 1 mm. At termen appearing to widen on account of some yellow irroration.

Underside similar, but in part with stronger blue and purple reflections, the yellow markings somewhat extended, the fore wing with some additional yellow scales in and distally to the posterior angle of the cell and at distal end of abdominal margin.

Aru Is., March–May 1916 (*W. J. C. Frost*).

Family Geometridæ.

Subfam. *STERRHINÆ*.

2. *Semæopus subtranslucens*.

♀.—33 mm.

Head and body nearly concolorous with wings; antennal joints not projecting; ciliation fully as long as diameter of shaft; pectus not densely hairy.

Fore wing with apex acute, termen rather irregularly subcrenulate; proximal areole ample, distal minute, SC^2 arising well down on the stalk of SC^{3-5} ; subdiaphanous whitish, with slight pink reflections and with some somewhat olivaceous* irroration; costal margin and base olivaceous*; markings olivaceous*, antemedian line before one-third, excurved in cell and in submedian area; cell-mark ocelloid; median line dentate, from five-eighths costa, oblique outwards to SC^5 , somewhat incurved between the radials and strongly behind middle, reaching hind margin about middle; a duplicating line just beyond the median commences about R^1 , feeble at first but becoming distinct and thickening, almost connected with median by olivaceous shading in posterior part; postmedian line dentate, placed midway between this and termen or slightly nearer the

* "Buff with a tinge of olive" would perhaps better describe this shade.

latter, very oblique outwards between SC^4 and SC^5 , where it is acutely angulated, incurved and thickened into two spots between the radials and again (though less strongly) behind M^2 ; terminal line olivaceous, accompanied by triangular interneural dots (pointing proximad).

Hind wing with termen irregular, dentate, the teeth at R^1 and R^3 longest and sharpest; R^2 very shortly stalked, M^1 arising rather nearer R^3 ; irroration in proximal half in part fuscous; first line wanting; cell-spot round, black, without pale centre; the other markings corresponding to those of fore wing.

Underside paler; fore wing with costal margin somewhat olivaceous; both wings with cell-spot ocelloid, median and postmedian and terminal markings nearly as above.

Sierra del Libane, Colombia, 6000 feet (*H. H. Smith*).

Rather recalls *S. trygodata*, Warr. (Nov. Zool. xi. 36), but distinguishable by the relatively long antennal ciliation and longer teeth of termen of hind wing, as well as by the venation. These two species together with "*Trygodes*" *pertumna*, Schaus, so far bridge over the supposed gap between *Semaeopus* and *Trygodes* that I doubt whether the latter can be regarded as more than a section.

3. *Anisodes (Brachycola) clandestina*.

♂.—32 mm.

Structure of antenna, palpus, legs, areole, etc., approximately as in *absconditaria*; palpus with second joint beneath perhaps clearer whitish and more appressed-scaled; abdominal cavity enormously developed, the sternal tuft less developed. Smaller, wings shorter, irroration fairly strong, purple-reddish (in *absconditaria* extremely weak, browner), underside more strongly marked, including some rather noticeable pink irroration at middle of costa of hind wing.

Khasis, type in coll. Joicey; 1 ♂ in coll. L. B. Prout (genitalia examined by Rev. C. R. N. Burrows). Pundaloya, Ceylon (coll. Tring Mus.). Penang and Gunong Ijan (coll. Tring Mus.)—ocelloid form of central spot persisting (in type giving place to punctiform).—Larut Hill, Perak, 4360 ft., 21st April, 1898 (*S. S. Flower*), 1 ♀; Singapore (*H. N. Ridley*), a good series; Sarawak, 1 ♂ ♀ (*Wallace*) (coll. Brit. Mus.).

This is essentially the *obrinaria* of Hampson's 'Fauna of British India, Moths,' iii. p. 446, although, on account of

shortage of material and preponderance of ♀ ♀ in the British Museum collection at that time, he mixed in some very heterogenous elements. *A. obrinaria*, Gn.=*caligata*, Walk.=*similaria*, Walk., and *A. pallida* (bon. sp.?) belong to the typical section *Anisodes* and have no areole. *A. obli-viaria*, Walk.=*suspicaria*, Snell., to the section *Perixera*, Meyr. (nec Hamps.), also with no areole, but with hind femur tufted.

I should have considered this a local form—more rufescent—of *niveopuncta*, Warr. (Nov. Zool. iv. p. 48), but the genitalia show that it has reached full specific rank. In *niveopuncta* the uncus is more long and slender, the valves very different, the penis has a very distinct cornutus (or perhaps bunch of cornuti), and there is a better developed pair of hair-brushes on the 4th (?) abdominal segment.

4. *Flavinia allogaster*.

♂.—30 mm.

Closely similar to *circumdata*, Maassen (Stübel's Reisen, Lep. pp. 101, 130, t. iv. f. 22). Abdomen with a pale dorsal line as in *alcidamea*, Druce (Proc. Zool. Soc. Lond. 1890, p. 498).

Fore wing with the apical black border broadened, its proximal edge on the upper surface at R^1 being over 4 mm. from the apex, at R^2 fully 3 mm. from termen, on the under surface very slightly less broad; black on hind margin slightly broadened.

Hind wing with the black distal border above less narrowed between R^1 and M^2 .

Peru, without more exact locality. Type in coll. Joicey (ex Schaus); three in coll. Brit. Mus. from the same source, mixed with true *circumdata*.

Family Drepanidæ.

5. *Cyclidia substigmara*, Hbn.

It has been unaccountably overlooked that this species was described and figured by Hübner ('Zuträge,' iii. 29, figs. 519–520) from "China," i. e. no doubt S. China, and represents unmistakably the form later described by Walker (List Lep. Ins. xxiv. 1121) from Hong Kong as "*Abraxas*" *capitata*, though the last-named author neglects to describe the underside. The common Indian race, which has for so long passed as *substigmara* (see, for instance, Hampson's 'Fauna

of British India, Moths,' vol. i. pp. 327, 328, fig. 225, Strand in Seitz 'Macrolepidoptera,' vol. ii. p. 196, pl. 23f), therefore remains without a name and I propose to call it *Cyclidia substigmatica superstigmatica*, subsp. nov. Ground-colour whitish, markings fawn-brownish, always more or less shadowy, subternal spots at inner margin of fore wing well defined, *cell-spot of hind wing above black*.

Dharmasala, Kulu, Sikkim, Burma, etc.; type ♂ (Darjeeling, ex coll. Lidderdale) in coll. Joicey.

From Vrianatong, Tibet, comes a greyer, more suffused race, with the cell-spot of the hind wing above generally less deep black than in the form *superstigmatica*, the subternal brown markings of fore wing not, or scarcely, more strongly developed than the posterior end of the line which precedes them proximally. I name this *substigmatica intermedia*, subsp. nov. Type in coll. Joicey.

Typical *substigmatica* from China and Formosa (also, in Tring Museum, from Tonkin) is very similar to subsp. *intermedia*, but less dark grey, the cell-spot of the hind wing above still weaker, the subterminal dots generally connected by stronger grey shading, the subternal markings of the fore wing frequently confluent with the preceding line so as to form a brownish pyramid, the cell-spots generally less intensely black.

The Japanese representative, *nigralbata*, Warr. (Nov. Zool. xxi. p. 401), may possibly be a separate species, though most collections have mixed it with "*capitata*" (i. e., *substigmatica substigmatica*), not even recognising the marked distinctions as racial.

Family Arctiidae.

Subfam. *LITHOSIANÆ*.

6. *Caprimima esthla*.

♂ ♀.—31–32 mm.

Similar to *C. calida*, Walk., but larger. The yellow on patagia and tegulae more extended.

Fore wing with the yellow area broad, the black at base rather broad, especially in the ♀, where it curves outwards along costal margin, the black costal margin in middle very narrow in ♀, wanting in ♂.

Hind wing rather more produced in ternal region than in *calida*, the black along abdominal margin broad, at apex moderately broad, at distal margin between M¹ and tornus, on the other hand, quite narrow (recalling *isabellæ*, Rothsch.);

apical area wanting the "cupreous-red" cloud which in *calida* is always present beneath and generally also above.

Goodenough I., 2500-4000 ft., Apr. 1913 (*A. S. Meek*). Type ♂, 2 ♀ ♀ in coll. Joicey. Also in Tring Museum.

Possibly a local form of *calida*, though very different from Hampson's "ab. 1."

Subfam. *ARCTIINÆ*.

7. *Heliactinidia tornensis*.

♂.—30 mm.

Similar to *chiguinda*, Druce.

Fore wing slightly more rounded, rather blacker brown; streak behind cell longer, crossing base of M^2 ; outer band broader, not indented at posterior extremity of cell.

Hind wing without the black costal area; the streaks on submedian fold and in abdominal area wanting.

Torné, Cauca Valley, Colombia, August 1907. Type in coll. Joicey.

Family Hypsidæ.

8. *Phægorista bisignibasis*.

♀.—58 mm.

Head and thorax above black; face marked with white at lower extremity, occiput and front of thorax narrowly marked with white; breast and palpus beneath (to near end of second joint) orange; abdomen orange with narrow black anterior rings; legs orange marked with black, tarsi mostly black; antennal joints not projecting.

Fore wing light reddish orange, along costal and hind margins narrowly and irregularly black; a small black patch at base, with its outer edge convex and containing a pure white basal spot, close to costa; apical region black, its boundary rather straight from proximal end of areole in direction of tornus but narrowly interrupted at submedian fold, followed by a black subternal and a small whitish ternal spot between SC^1 and M^2 placed in the apical patch near its proximal edge, slightly broader than in *agaristoides*, Bdv., but proximally indented in the middle; fringe spotted and tipped with white.

Hind wing scarcely more reddish; a black distal border about as in *agaristoides*.

Underside similar, fore wing without white ternal spot.

Tanga, German E. Africa, February. Type in coll. Joicey.

9. *Phægorista trialbata*.

♂.—85 mm.

Akin to *agaristoides*, differing as follows:—Palpus with third joint shorter; second joint beneath narrowly marked with white (in *agaristoides* less narrowly with orange).

Fore wing above with the oblique streak behind cell larger and narrower, pinkish white; a small long-oval pinkish-white spot in front of it, beyond middle of cell; subapical patch white, as in some *agaristoides*, but considerably broader and somewhat longer, reaching vein M^2 , its distal edge irregularly curved; no supplementary spot on submedian fold; fringe not white at apex.

Hind wing with the border narrower than in *agaristoides*; orange ground-colour less reddish than in most *agaristoides*. *Fore wing* beneath orange as far as the black apical area, only with the costal margin narrowly black.

Uganda (*E. S. Gledhill*). Type in coll. Joicey.

XXXIX.—*Descriptions and Records of Bees*.—LXXXI.

By T. D. A. COCKERELL, University of Colorado.

Augochlora (Odontochlora) lyoni, sp. n.

♀.—Length about 8.5 mm., anterior wing 6.

Robust, black, with strong metallic tints as follows: clypeus (which is smooth, with well-separated large punctures) green in middle and purplish at sides; cheeks blue-green next to orbits, otherwise purplish; region on each side of antennæ obscurely purplish; vertex greenish; tubercles bright green; mesothorax with disc obscurely green, margins purple; scutellum greenish; postscutellum and area of metathorax purple; mesopleura dark purple edged with blue; first abdominal segment suffused sublaterally with bright green and purple; second with similar colours, but less distinct, the remaining segments black. Flagellum ferruginous beneath; front dull and granular; ocelli not enlarged; process of labrum broadly truncate, slightly bigibbous; mesothorax densely punctured, except the posterior middle, where the punctures are sparse on a shining ground; area of metathorax with numerous very fine more or less wrinkled striæ; posterior face with no

sharp margin; tegulæ reddish. Wings dusky, stigma and nervures pale yellowish brown; first r. n. meeting second t.-c. Legs reddish piceous, with pale pubescence; hind spur simple. Abdomen shining, thinly hairy, with very small punctures; first dorsal segment with a low tubercle on middle of disc; first ventral segment with a long slender spine; last dorsal segment with fuscous hair.

San Julian, Venezuela, July 19, 1900 (*M. W. Lyon, Jr.*). U.S. Nat. Museum.

Nearest to the Mexican *A. zophodes* (*Halictus zophodes*, Vachal), but distinguished by the smooth and shining surface of clypeus, with well-separated punctures. The tubercle on the first dorsal segment of abdomen recalls the Australian *Halictus mirandus*, Ckll.

Agapostemon viequesensis, sp. n.

♀.—Length about 8 mm., anterior wing 6.

Head and thorax brilliant bluish green; lower margin of clypeus broadly black; labrum and mandibles red, the latter black subapically; sides of face and front suffused with purple-blue; flagellum dull ferruginous beneath, but the last joint bright ferruginous on both sides; clypeus and supraclypeal area shining; mesothorax dull, minutely granular; scutellum rather yellowish green, shining, somewhat bigibbous; area of metathorax purple, poorly defined, with obscure rugæ; posterior truncation bright green, with a sharp edge; tegulæ light ferruginous. Wings dusky hyaline, stigma clear honey-colour; second s.m. receiving first r. n. a considerable distance from its end. Legs light ferruginous, with pale yellowish hair, that on outer sides of tibiae more or less fuscous. Abdomen mainly yellowish green, with blue-purple shades on apical half, but the first three segments have transverse median bands of reddish brown, where the surface is not metallic; bases of segments with pale tomentum; venter mainly pale fulvous.

Vieques Island, Porto Rico, West Indies, Feb. 1899 (*Aug. Busck*). U.S. Nat. Museum.

In Vachal's table it runs out at 14, and it is scarcely to be compared with any described species. The extreme bases of the abdominal segments are testaceous, but the apical margins sliding over them are not noticeably discoloured.

Neocorynura discolor (Smith).

Augochlora tisiphone, Gribodo, is a synonym. Smith's

type was from Oajaca, and Gribodo's was marked "Oajuca?" (*sic*).

The following species are now recorded from new localities:—

Augochlora radians (Vachal). Cacao, Trece Aguas, Alta Vera Paz, Guatemala, April 25 (*Schwarz and Barber*).

This is probably the same as the so-called *A. vesta* from Mexico in the British Museum, but it is not true *vesta*.

A. fervida, Smith. Tlahualilo, Durango, Mexico, at peach blossoms (*A. W. Morrill*).

A. illustris (Vachal). Colombia, from C. F. Baker collection.

A. phæmonoë (Schrottky). Sapucay, Paraguay, March (*W. T. Foster*).

A. nigrocyanea, Ckll. Tampico, Tamaulipas, Mexico, Dec. 6 (*F. C. Bishopp*).

A. esox (Vachal). Paraiso, Canal Zone, Panama, Jan. 18 (*Aug. Busck*).

A. seminigra, Ckll. Cordoba, Mexico, Jan. 20 (*F. Knab*).

The *A. nigrocyanea* females from Tampico are variable; one has strong purple tints on apical part of abdomen, which the other lacks; the latter has the mesothorax black.

Xenoglossa howardi, sp. n.

♂. (Type).—Length about 12 mm., anterior wing 9.

Black, including the clypeus and antennæ; mandibles fulvous apically, bidentate, but with a slight notch on inner side indicating the rudiment of a third tooth; labrum brown at sides, covered with appressed pale hair; maxillary palpi 5-jointed; hair of head long and creamy white, with some fuscous hairs on vertex and below antennæ; hair of thorax above clear reddish fulvous, without black; a large patch on middle of mesopleura, and tubercles, with dark fuscous hair; tegulæ ferruginous. Wings dusky. Legs black, the spurs stramineous, and tarsi at apex ferruginous; hair of middle and posterior tibiæ and tarsi dark brown, but the femora and anterior legs with pale hair. Abdomen shining black, minutely punctured, hind margins of segments 2 to 4 suffusedly reddened; no hair-bands, but base of second segment at sides with thin greyish hair; venter with thin whitish hair.

♀.—Length about 12.5 mm.

Similar to the male, but all the legs with dark brown

hair; dark brown hair on sides of thorax more extensive; second and third abdominal segments with a thin transverse band of greyish tomentum, not conspicuous.

Type (male) from the Federal District, Mexico (*J. R. Inda*, 56). U.S. Nat. Museum. Female from Oaxaca, Mexico, Sept. 18 (*L. O. Howard*).

Related to *X. assimilis* (Smith), but without the black patch of hair on thorax above in female. The male antennæ are formed as in *X. pruinosa* (Say). The species belongs to the subgenus *Peponapis* of Robertson, though differing from his type-species in the black clypeus of male and reduction of pale hair on female abdomen.

Allodape candida, Smith.

♀.—Mkonumbi, near Lamu, Tana River, E. Africa, Sept. 1892 (*Chanler Exped.*).

This differs slightly from Smith's description, and from a specimen from Abyssinia, sent by Gribodo, in that the light band on clypeus is not at all widened at the lower end.

Leptergatis globulifera, sp. n.

♂.—Length 6–6.5 mm.

Black, with the long flagellum dull ferruginous beneath, tegulæ rufo-piceous, legs more or less suffused with reddish, the tarsi and tibiæ at apex ferruginous.

Close to *L. armata* (Smith), differing thus: scape dark; ocelli closer together; clypeus and labrum entirely black, mandibles mainly dark reddish; tegulæ darker; abdominal hair-bands less distinct; wings a little more dusky. The hind legs are practically as in *L. armata*. The co-type has the mandibles paler, with a large pale yellowish spot, beyond which they are ferruginous.

Venezuela; type from Aroa, Dec. 12, 1910 (*M. A. Carriker*). U.S. Nat. Museum. Another is from Lagunita de Aroa, 2000 ft. alt. (*M. A. Carriker*).

Prosopis holomelæna, sp. n.

♀.—Length about 6 mm., anterior wing 4.5.

Entirely black, without light markings; robust, with no depression between first and second dorsal abdominal segments; clypeus long, dull, the punctures very indistinct; apical part of flagellum bright ferruginous beneath; punctures of mesothorax and scutellum excessively minute, the

surface between them microscopically rugulose; area of metathorax with irregular rugæ; tegulæ black. Wings slightly dusky, stigma and nervures very dark; second s.m. long; recurrent nervures meeting the transverso-cubitals; tibiæ and tarsi with some pale hair. Abdomen shining, impunctate, the surface with a delicate microscopical tessellation.

Buitenzorg, Java, March 10, 1909 (*Bryant and Palmer*). U.S. Nat. Museum.

Nearest to *P. impunctata*, Friese, but easily separated by the entirely black face.

Prosopis coroicensis, sp. n.

♂.—Length about 7.5 mm., anterior wing 6.2.

Black, robust, without yellow markings on thorax or legs; face long, eyes very long; clypeus (except a narrow dark stripe on each side), large supraclypeal mark (rounded above), lateral face-marks (extending along orbital margins halfway up front, where they end obtusely, shaped like feet on tip-toe, with very long tapering toes), all bright chrome-yellow; antennæ piceous; scape very short; mandibles stout, suffused with reddish; front dull, very densely and finely punctured; mesothorax and scutellum dull, with very large well-separated punctures; mesopleuræ with large sparse punctures; area of metathorax with coarse transverse and longitudinal ridges; posterior truncation very coarsely sculptured, flat, with well-defined margins; tegulæ piceous. Wings deep fuliginous; first r. n. joining first s.m. considerably before its end. Legs more or less reddish, the anterior tibiæ dusky ferruginous in front. Abdomen shining, without hair-bands; first two segments quite strongly punctured, third with minute punctures; first ventral segment emarginate at apex.

Coroico, Yungas, Bolivia, May 1, 1899. U.S. Nat. Museum. No collector's name is given.

By the venation this resembles *P. petroselini*, Schrottky, but it is easily separated by the fuliginous wings and other characters.

Prosopis tricolor, Schrottky.

♀.—Differs from the male thus: clypeus with an elongate-cuneiform rufo-fuscous mark on each side; antennæ entirely ferruginous; yellow band on prothorax interrupted in

middle ; marks at bases of tibiae cream-colour. Schrottky only described the male.

San Bernardino, Paraguay, Oct. 21 (*K. Fiebrig*). U.S. Nat. Museum.

Prosopis flavohumeralis, sp. n.

♀.—Length about 6 mm., anterior wing 4·5.

Black, with yellow markings; mandibles ferruginous; labrum black; clypeus yellow except narrow lower margin and a stripe on each side, failing above; supraclypeal mark broadly subtriangular, while above it, on front, are two narrow yellow marks close together; lateral face-marks extending nearly to summit of eye, where they are broadly but very obliquely truncate, and diverge a little from the orbital margin; scape and flagellum dusky ferruginous beneath, darker above; front very densely and minutely punctured, vertex more coarsely; tubercles and the sharp projecting anterior lateral angles of prothorax yellow, but no other yellow on thorax; mesothorax and scutellum perfectly dull and coarsely punctured; area of metathorax with raised lines in the form of a square, but without the sculpture, except a microscopical cancellation all over; posterior truncation distinct; tegulae with a yellow spot. Wings dusky; recurrent nervures meeting transversocubitals; marginal cell broad (deep). Legs with anterior tibiae yellow in front, the others at base; tarsi more or less reddish. Abdomen shining, without hair-bands; first segment distinctly though minutely punctured, second and third extremely sparsely and indistinctly.

San Bernardino, Paraguay (*K. Fiebrig*). U.S. Nat. Museum.

In Schrottky's tables of Paraguay species this runs to *P. itapuensis*, Sky., but differs by the dusky wings and spots on angles of prothorax. It seems to closely resemble *P. lychnis*, Vachal, differing in the punctuation of the abdomen.

Prosopis howardiella, sp. n.

♂.—Length about 3·5 mm.

Head all black except a large obtusely trilobed (the sides concave) pale yellow patch on clypeus; scape black; flagellum thick, ferruginous beneath; thorax entirely black; mesothorax and scutellum with sparse very minute punctures on a microscopically tessellate surface; area of metathorax

large, with a few small irregular basal plicæ, and a median raised line continuous to hind margin; posterior truncation of metathorax not clearly defined as usual, its upper lateral corners not defined at all, but its upper middle separated by a short ridge from the basal area, while an oblique ciliated ridge limits it on each side; abdomen impunctate, microscopically transversely lineolate, first segment narrowed. Wings clear, very faintly dusky apically; recurrent nervures ending a little before the transverso-cubitals; second submarginal cell nearly square, its inner and outer sides parallel; bases of tibiæ, and anterior tibiæ in front, cream-colour; tarsi pale ferruginous.

Oaxaca, Mexico, April 30 (*L. O. Howard*). U.S. National Museum.

Looks like some small Pemphredonid wasp, but is a true bee, with many plumose hairs on body. It is more or less related to Vachal's *P. recisa*, *P. puerula*, *P. fissa*, &c., but much smaller and very distinct.

Prosopis subgrisea, sp. n.

♀.—Length about 7 mm., anterior wing 5·3.

Black, with yellowish-white or brownish-white markings; mandibles and labrum black; clypeus long, black, the lower margin suffusedly reddish, but with a cream-coloured stripe running down its middle (not quite reaching upper end), not quite so broad as the area on either side; supraclypeal mark small, roundish; lateral face-marks linear, extending along orbital margins nearly halfway up front; scape and base of flagellum ferruginous, rest of flagellum black above and faintly reddish below; front appearing granular; upper part of prothorax with linear light margin, and greater part of tubercles light; a light band covering anterior half of scutellum, a band on postscutellum, and axillæ light; mesothorax dull, coarsely punctured; area of metathorax with coarse rugæ; posterior truncation and sides of metathorax densely covered with pale grey tomentum; pleura sparsely punctured; tegulæ with a light spot. Wings brownish hyaline, with the costal field, including marginal cell and beyond, fuliginous; hind tibiæ with rather more than basal half white. Abdomen dullish, the punctures excessively minute and close; first and second segments with yellowish-white marginal hair-bands, third to fifth with hind margins obscurely pallid; apex with dark fuscous hair.

San Rafael, Jicoltepec, Mexico. U.S. National Museum. From the Ashmead collection; no doubt collected by C. H. T. Townsend.

Resembles *P. mexicana*, Cresson, but easily separated by the linear lateral face-marks, and other characters. It is evidently closely allied to *P. maculipennis*, Smith, known only in the male, but that has yellow markings and the first abdominal segment rather strongly punctured.

Prosopis knabi, sp. n.

♂.—Length about 3.75 mm., anterior wing 3.

Black, with yellow markings; scape black, broadly red at end, and largely in front; flagellum entirely bright ferruginous, a little darker above; clypeus entirely, subtriangular supraclypeal mark (broader than long), and lateral face-marks all light yellowish, the latter ending obtusely on orbital margin about halfway up front (former practically as in *P. episcopalis*, Ckll.); pale marks of thorax confined to tubercles and a broadly interrupted line on prothorax above; tegulæ testaceous, hyaline in front, with a yellow spot; mesothorax closely and strongly punctured, scutellum rather more sparsely, the surface between the punctures smooth; base of metathorax with strong longitudinal and transverse rugæ, but the sculpture is mainly and essentially transverse; whole sides of thorax strongly punctured, the metathorax at sides bare (without grey tomentum); knees, anterior tibiæ (except a large patch behind), middle and hind tibiæ very broadly at base and narrowly at apex, and the tarsi all pale yellow. Wings clear; stigma and nervures sepia; first recurrent nervure joining first submarginal cell a short distance before its end. Abdomen appearing impunctate under a lens, but the microscope shows minute punctures on first segment.

Champerico, Guatemala, Aug. 4, 1905 (*Frederick Knab*). U.S. National Museum.

This minute species recalls some of those of the United States, such as *P. modesta*, Say, but it will be readily known by the red flagellum and transverse rugæ at base of metathorax.

The following localities are new:—

Prosopis mexicana, Cresson. Tampico, Mexico, Dec. 15 (*E. A. Schwarz*); Frontera, Mexico.

Prosopis azteca, Cresson. San Rafael, Jicoltepec, Mexico (*L. O. Howard*).

XL.—On some Fishes from the Shari River, with Descriptions of Two new Species. By G. A. BOULENGER, F.R.S.

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M. A. BAUDON, Administrator of the Ubanghi-Shari Colony, French Equatorial Africa, has kindly sent me, for the British Museum, a little series of small fishes from the Shari River, containing examples of two species not included in Dr. Pellegrin's excellent book 'Les Poissons du Bassin du Tchad,' and of two others that are undescribed.

The genus *Barbus*, as yet unknown from that Basin, is represented by two species: *B. pleuropholis*, Blgr., previously recorded from the Congo, the Aruwimi, and the Uelle, and *B. baudoni*, sp. n. The Cyprinodonts belong to two species: *Haplochilus acuticaudatus*, Pellegr., and *H. hutereaui*, Blgr., the latter recently discovered in the Uelle. Other species are *Anabas petherici*, Gthr., *Tilapia melanopleura*, A. Dum., *Eleotris nana*, Blgr. *, and *Andersonia brevior*, sp. n., belonging to a very remarkable genus of Siluridæ, of which a single species was known: *A. leptura*, Blgr., from the Upper Nile and the Bahr-el-Gebel.

Barbus baudoni.

Depth of body equal to length of head, $3\frac{2}{3}$ to $3\frac{3}{4}$ times in total length. Snout rounded, shorter than the eye, which is $2\frac{2}{3}$ times in length of head and equals interorbital width; mouth small, terminal, with thin lips; no barbels. Dorsal III 8, equally distant from centre of eye and from caudal, border very feebly concave; last simple ray not enlarged, not serrated, a little shorter than head. Anal III 5, not reaching caudal. Pectoral about $\frac{3}{4}$ length of head, not reaching ventral; base of latter below middle of dorsal. Caudal peduncle $1\frac{1}{2}$ times as long as deep. Scales radiately striated, 23–24 $\frac{3\frac{1}{2}}{3\frac{1}{2}}$, 2 between lateral line and ventral, 8 round caudal peduncle. Yellowish brown above, silvery beneath; a band of crowded black dots from the gill-opening to the base of the caudal; on this band, three round black spots, the first just in front of the dorsal, the second just behind the latter,

* These specimens connect the Nile fish with *E. uellensis*, Blgr., which is probably not entitled to stand as a distinct species.

the third at the base of the caudal ; a fourth black spot above the anterior rays of the anal.

Total length 30 mm.

Allied to *B. trispilomimus*, Blgr., from the Ogowe and Lower Congo.

Andersonia pellegrini.

Depth of body 9 times in total length, length of head 6 times. Head $1\frac{1}{2}$ times as long as broad ; snout obtusely pointed, as long as postocular part of head, 3 times as long as diameter of eye, which is $\frac{2}{5}$ interorbital width. Maxillary barbel twice as long as inner mandibular, and $\frac{3}{4}$ length of head. Median occipital process $3\frac{1}{2}$ times as long as broad, narrower than and $1\frac{1}{2}$ times the length of the laterals. Dorsal I 6, twice as distant from end of snout as from caudal, first ray as long as head. Anal 9. Pectoral $\frac{3}{4}$ length of head. Caudal peduncle a little more than $\frac{1}{3}$ of the total length. 24 dorsal and 21 ventral scutes, the last 9 on caudal peduncle. Greyish above, with four rather indistinct dark bars across the back ; dorsal blackish in the distal third.

Total length 42 mm.

Closely allied to *A. leptura*, Blgr. Distinguished by the smaller eye and the different proportions of the occipital processes.

Named in honour of the distinguished author of the 'Poissons du Bassin du Tchad.'

XLI.—*Descriptions of new South-American Batrachians.*

By G. A. BOULENGER, F.R.S.

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Phyllobates kingsburyi.

Head slightly longer than broad. Snout rounded-subtruncate, projecting beyond the mouth, as long as the orbit ; loreal region vertical ; nostril nearer the tip of the snout than the eye ; interorbital space broader than the upper eyelid ; tympanum very distinct, half the diameter of the eye, 3 to 4 times its distance from the latter. Fingers moderate, first and second equal, or first slightly the longer ; disks rather

small; subarticular tubercles feebly prominent. Tibio-tarsal articulation reaching the eye; tibia half the length of head and body. Toes moderate, perfectly free, the disks larger than those of the fingers but smaller than the tympanum; subarticular tubercles feebly prominent; two small metatarsal tubercles, inner oval, outer round; an oblique fold along the distal half of the tarsus. Skin of upper parts finely shagreened, of lower parts smooth. Brown above, with a paler dorso-lateral streak; a black streak round the snout, continued, as a broad band, on the side of the body; usually a white streak along the upper lip, continued along the body to the groin, edged below, on the body, by a black streak or series of spots; limbs brown, with dark brown spots, arm and thigh lighter, with a dark brown streak in front and behind; lower parts white, uniform on throat and breast mottled with greyish brown.

From snout to vent 28 millim.

Four specimens from El Topo, Rio Pastaza, Eastern Ecuador, altitude 4200 feet; from Mr. M. G. Palmer's collection, 1912.

Named in pious memory of my late Attendant, Frederick Kingsbury, killed in action in Palestine, Feb. 25, 1918.

Dendrobates ranoides.

Head slightly longer than broad. Snout truncate, very feebly projecting beyond the mouth, longer than the eye; loreal region vertical; nostril nearer the tip of the snout than the eye; interorbital space broader than the upper eyelid; tympanum very distinct, $\frac{2}{3}$ the diameter of the eye, 3 times its distance from the latter. Fingers rather slender, first and second equal; disks small, not much wider than the finger; subarticular tubercles very indistinct. Tibio-tarsal articulation reaching the eye; tibia half the length of head and body. Toes slender, perfectly free, the disks larger than those of the fingers but only about half the diameter of the tympanum; subarticular tubercles feebly prominent; two small metatarsal tubercles, inner oval, outer round; a curved fold along the distal half of the tarsus. Skin granulate, finely on the upper parts and belly, more coarsely on the sides. Reddish brown above, marbled with dark brown on the head and back and with blackish cross-bars on the limbs; a pale dorso-lateral streak; a black streak round the snout, continued, as a broad band, on the temple and along the side

of the body; tympanum reddish brown; lower parts white with numerous small black spots and vermiculations.

From snout to vent 22 mm.

A single specimen from Villavicencio, Quatiquia River, Colombia, altitude 400 feet. Presented by the Wellcome Bureau of Scientific Research.

Hylodes roseus.

Tongue oval, slightly nicked behind. Vomerine teeth in short transverse series considerably behind the choanæ. Head as long as broad; snout rounded, not projecting beyond the mouth; canthus rostralis indistinct; loreal region very oblique, concave; nostril twice as far from the eye as from the tip of the snout; interorbital space as broad as the upper eyelid; tympanum hidden. Fingers moderate, first a little shorter than second; disks large, a little broader than long; subarticular tubercles moderate. Tibio-tarsal articulation reaching the eye; tibia half the length of head and body. Toes moderate, perfectly free; disks as large as those of the fingers; subarticular tubercles small, feebly prominent; a single metatarsal tubercle, rather large and prominent. Skin smooth above, granular on the belly; three subconical tubercles on the upper eyelid. Grey above, with dark brown variegations; loreal region dark brown; a white streak on the canthus rostralis and on the edge of the upper eyelid, and a broader, dark-edged one from the eye to halfway down the side of the body; dark oblique bars on the sides of the head and body and on the limbs; upper eyelids and sides of body with deep pink spots; groin, sides of thigh, lower surface of arm, forearm, and tibia, and upper surface of tarsus and metatarsus deep pink; throat, belly, and lower surface of thighs grey, marbled with brown.

From snout to vent 27 mm.

A single specimen from Andagoya, Choco, Colombia. Presented by Dr. H. G. F. Spurrell in 1916.

Hylodes trachylepharis.

Tongue oval, entire or slightly nicked behind. Vomerine teeth in small groups just behind the choanæ. Head as long as broad; snout rounded, not projecting beyond the mouth; canthus rostralis distinct; loreal region oblique, concave; nostril nearer the tip of the snout than the eye; interorbital space as broad as the upper eyelid; tympanum distinct, half

the diameter of the eye. Fingers moderate, first a little shorter than second; disks rather large, round, smaller than the tympanum; subarticular tubercles rather small, feebly prominent. Tibio-tarsal articulation reaching the nostril or the tip of the snout; tibia $1\frac{2}{3}$ times in length of head and body. Toes moderate, perfectly free; disks a little smaller than those of the fingers; subarticular tubercles small, feebly prominent; two metatarsal tubercles, inner oval, rather large and prominent, outer round and small. Upper parts with small glands, belly granular; upper eyelids with several subconical tubercles. Brown above, back and sides of head yellowish; a >-<-shaped black marking behind the back of the head, the antero-lateral branches of which extend to the eyes; a dark canthal streak, and two dark bars from the eye to the edge of the mouth; an oblique dark temporal streak; limbs with dark cross-bars; sides of thighs deep pink; lower parts, throat, and breast finely speckled with brown.

From snout to vent 20 mm.

Three specimens from El Topo, Rio Pastaza, E. Ecuador, 4200 ft.; from Mr. M. G. Palmer's collection, 1912.

Leptodactylus hololius.

Tongue oval, slightly nicked behind. Vomerine teeth in long, slightly oblique series behind the choanæ, not extending outwards beyond the vertical of the inner borders of the latter. Head as long as broad; snout rounded, scarcely projecting beyond the mouth; canthus rostralis indistinct; loreal region oblique, slightly concave; nostril equidistant from the eye and from the tip of the snout; interorbital space as broad as the upper eyelid; tympanum very distinct, half the diameter of the eye. Fingers moderate, obtuse, first a little shorter than second; subarticular tubercles rather large and very prominent. Tibio-tarsal articulation reaching the eye; tibia a little less than half the length from snout to vent. Toes slender, obtuse, perfectly free, not margined; subarticular tubercles moderately large, very prominent; two small metatarsal tubercles, inner oval, outer round; no tarsal fold. Skin perfectly smooth; no dorso-lateral fold. Pale brown above, with dark brown spots; a dark cross-bar between the eyes, followed by a rhombic spot; a Λ -shaped dark marking between the shoulders; limbs with rather indistinct dark cross-bands; lower parts white.

From snout to vent 26 mm.

A single specimen from Pebas, R. Marañon, Peru ; from the collection of Mr. J. J. Mounsey, 1913.

Leptodactylus diptychus.

Tongue oval, rather strongly nicked behind. Vomerine teeth in long transverse series behind the choanæ, not extending outwards beyond the vertical of the inner borders of the latter. Head as long as broad ; snout rounded, projecting considerably beyond the mouth ; canthus rostralis indistinct ; loreal region oblique, slightly concave ; nostril a little nearer the end of the snout than the eye ; interorbital space a little narrower than the upper eyelid ; tympanum very distinct, two-thirds the diameter of the eye. Fingers moderate, obtuse, first much longer than second ; subarticular tubercles large and very prominent. Tibio-tarsal articulation reaching between the eye and the nostril ; tibia half the length from snout to vent. Toes slender, obtuse, perfectly free, not margined ; subarticular tubercles rather large, very prominent ; two metatarsal tubercles, inner oval and about half as long as the inner toe, outer round and very small ; a tarsal fold. Skin smooth above, with small warts on the sides of the body ; a glandular fold above and behind the tympanum and another, narrow but prominent, from behind the upper eyelid to the hip ; throat and belly smooth, with a groove defining a ventral disk ; lower surface of thighs granulate. Greyish brown above, the dorso-lateral folds lighter ; tympanum reddish brown ; a dark brown canthal streak ; temporal fold edged with blackish ; lips with dark brown spots ; a brown bar between the eyes and a Λ -shaped marking between the shoulders ; limbs with narrow dark brown cross-bars ; a white streak, edged on both sides with dark brown, along the back of the thighs ; lower parts white.

From snout to vent 44 mm.

A single specimen from the Andes of Venezuela.

Leptodactylus laticeps.

Tongue roundish, entire. Vomerine teeth in very long, slightly curved transverse series behind the choanæ, extending outwards to below the centre of the latter. Head much broader than long, much depressed ; snout broadly rounded, scarcely projecting beyond the mouth ; canthus rostralis indistinct ; loreal region very oblique, slightly concave ;

nostril nearer the end of the snout than the eye; tympanum very distinct, nearly as large as the eye. Fingers rather short, very obtuse, first much longer than second; subarticular tubercles large and very prominent. Tibio-tarsal articulation reaching the posterior border of the eye; tibia $2\frac{1}{4}$ times in length from snout to vent. Toes rather short, obtuse, perfectly free, not margined; subarticular tubercles small, prominent; two metatarsal tubercles, inner elliptic and two-thirds the length of the inner toe, outer round; no tarsal fold. Skin smooth; no folds on the back. Pale brown above, with large roundish black spots on the back and sides and on the upper surface of the head; five very regular vertical black bars on each side of the head, traversing the mouth, separated by narrower whitish bars; tympanum blackish, whitish in the centre; limbs with black cross-bars; whitish beneath, spotted with black.

From snout to vent 85 mm.

A single specimen from Santa Fé, Argentina, received from Mr. Falkland Ricketts in 1898.

Hyla leptoscelis.

Tongue circular, entire and slightly free behind. Vomerine teeth on a level with the posterior borders of the very large choanæ, in slightly curved oblique series forming a chevron pointing forwards. Head as long as broad, very strongly depressed; snout rounded, not projecting, as long as the eye; canthus rostralis obtuse; loreal region very oblique, feebly concave; nostril near the tip of the snout; interorbital space a little broader than the upper eyelid; tympanum distinct, half the diameter of the eye. Fingers moderate, with moderately large disks, outer with a slight rudiment of web; no projecting rudiment of pollex. Hind limb extremely slender; tibio-tarsal articulation reaching a little beyond the tip of the snout; tibia eight times as long as broad, $\frac{2}{3}$ the length of head and body. Toes $\frac{2}{3}$ webbed; a feeble tarsal fold. Skin smooth, granular on the belly and under the thighs; heel with a pointed dermal appendage, which is half as long as the eye. Yellowish above, with purplish-brown markings; a large spot on the snout, two V-shaped bands between the eyes, two cross-bars on the back, a V-shaped band on the sacral region, and angular cross-bars on the limbs.

From snout to vent 26 mm.

A single specimen from Lago do Iachy, above São Paulo

de Clinenca, R. Solimoens, Brazil; from the collection of Mr. J. J. Mounsey, 1913.

Hylella ocellata.

Tongue circular, entire, and slightly free behind. Head broader than long, very strongly depressed; snout rounded, not projecting, as long as the eye, which is obliquely turned forward; no canthus rostralis, loreal region feebly concave; nostril near the tip of the snout; interorbital space broader than the upper eyelid; tympanum distinct, $\frac{2}{3}$ the diameter of the eye. Fingers rather long, with moderately large disks, outer one-fourth webbed. Hind limb very slender; tibio-tarsal articulation reaching beyond the tip of the snout; tibia seven times as long as broad, $\frac{2}{3}$ the length of head and body. Toes $\frac{2}{3}$ webbed. Skin smooth, belly granular. Violet-blue above (in spirit), with round white spots, which are small and crowded on the sides of the head and on the limbs and large and scattered, and surrounded by a blackish ring, on the back; the blue colour forms a very narrow band on the thigh; upper lip with a white edge; sides and lower parts white.

From snout to vent 29 mm.

A single specimen from Huancabamba, E. Peru, above 3000 feet (coll. E. Boettger, 1912).

XLII.—*Notes on and Descriptions of some Sawflies from the Australian Region.* By S. A. ROHWER, Forest Insects, U.S. Bureau of Entomology, Washington, D.C.

THIS short paper, which is a contribution from the Branch of Forest Insects, United States Bureau of Entomology, contains the descriptions of four new species of sawflies. One of these species is especially interesting, because it represents a new genus which is the basis of a new subfamily.

The material upon which this paper is based was submitted for study by the British Museum (Natural History), and all the types will be returned to that institution.

Xiphydria obtusiventris, sp. n.

In Konow's table of *Xiphydria* this runs to *fumicornis*, Konow, but it differs from the description of that species in

a number of ways and does not seem to be closely allied. The unusual short ovipositor and ninth tergite cause the abdomen to be rounded, not tapering, apically, and gives this new species a distinctive appearance.

Female.—Length to end of abdomen 8 mm.; anterior margin of clypeus rounded, medianly depressed, but with a median protuberance, which at first sight gives the impression that there is a small median tooth; malar space about half as long as the width of mandibles at the base; surface of clypeus with dorsad-ventrad striæ; face and front reticulate; middle fovea small, indistinct; ocelli in a low triangle, the postocellar line longer than the ocellar line; vertex and posterior orbits finely aciculate; antennæ distinctly tapering apically, 18-jointed, the third joint distinctly longer than fourth but not as long as 4 plus 5; pedicellum not half as long as third joint; scape subequal in length with third joint; proscutum broad, well defined by foveolate notauli, but the median longitudinal furrow is feeble; surface of scutum and prescutum reticulate, with a more sparsely sculptured area at the anterior middle of prescutum and lateral middle of scutum; scutellum finely granular anteriorly, smooth and shining posteriorly; sides of pronotum granular, but with many longitudinal raised lines in addition; anterior part of mesepisternum reticulate, the posterior portion smooth, polished; abdomen finely granular, but the depressed apical margins of the tergites are almost without sculpture; ninth tergite short, rounded apically, giving the end of the abdomen somewhat the same appearance as in *Oryssus*; ovipositor broad; straight above, obtusely pointed apically and tapering from a broad base, not extending much beyond the apical margin of tergites; legs normal; venation usual, the intraradius joins the radius about one-fourth the length of the intraradius from the end of the second cubital. Black; antennæ and legs ferruginous; wings hyaline, with a faint yellowish tinge; venation pale brown, stigma dark brown; mandibles and sheath piceous.

Type-locality. Kuranda, N. Queensland, Australia.

Described from a single female collected May 3–June 2, 1913, by R. E. Turner at an altitude of 1100 ft.

Type. British Museum (Natural History).

ZENARGINÆ, subfam. nov.

Based on the genus *Zenarge* described below, and belongs to the family Argidæ, where it may be readily separated from either of the subfamilies by the following key:—

Subfamilies of Argidæ.

Anal vein complete and separate for its entire length ; first and second anal cells separated by an oblique interanal vein ; anella and recurrentella wanting.	<i>Zenarginæ.</i>
Anal vein either partly or entirely wanting ; first anal cell wanting or small and separated from the second by the submedian vein ; anella and re- currentella present	1.
1. Intercosta present	<i>Arginæ.</i>
Intercosta wanting	<i>Sterictiphorinæ.</i>

The Argids, largely because of their three-jointed antennæ, have long been considered as a distinct group, but most classifications have failed to show any relationship between them and such groups as the Perreyiidæ, Loboceridæ, or Pterygophoridæ. A study of these four families shows, however, that they have much in common, and it is not unlikely that they had a common origin and are phylogenetically closely allied. The subfamily Zenarginæ adds some evidence to this assumption, because it has certain characters which suggest an affinity with the Perreyiidæ and certain others which suggest Loboceridæ. The venation in the Zenarginæ is different from all other sawflies. The anterior wing probably represents a generalized Argid, because, with the exception of the complete anal vein, it presents nothing remarkable. The apex of the radial cell and the form of the radial and cubital cells, especially at the base, however, suggest *Loboceras*. The hind wing is much more specialized than the hind wing of the Argids, because of the loss of anella and recurrentella, and is not unlike *Perreyia*. The shape and foveolation of the head is not typical of the Argids, but recalls more the head of some of the Perreyiidæ.

In MacGillivray's classification the genus *Zenarge* runs to the subfamily Lophyrinæ, but it has but little in common with this group, and does not even resemble it closely in venation.

ZENARGE, gen. nov.

Genotype. *Zenarge turneri*, Rohwer.

Clypeus long, the dorsad-ventrad length nearly half as great as the apical width, the anterior margin rounded laterally and emarginate medianly, the dorsal margin composed of three sections, the lateral sections half the length of the median section, the entire dorsal margin sharply defined ;

labrum short, nearly truncate apically; malar space about one-third as long as the width of mandibles at base; inner margin of eyes slightly converging towards the clypeus, the area between them wider than high and the distance between them at the clypeus greater than the length of the eye; ocelli in a low triangle, the posterior ones distinctly in front of the supraorbital line; width of posterior orbits about two-thirds the cephal-caudad length of eye; antennæ 3-jointed, the third thickened apically in female, but nearly of a uniform thickness in male; pronotum well developed laterally; prescutum well defined and with a faint median longitudinal depression; anterior margin of the scutellum subangulate, the posterior margin rounded, the surface convex; first parapteron present, but in specimens in which the pronotum fits close it is concealed by a lobe-like projection of the pronotum; sternauli present but not sharply defined; mesepimeron large, with a cephal-caudad suture at about the middle; second pleural suture straight; third pleural suture straight; the metepisternum and metepimeron of equal height; propodeal spiracle large, elongate-oval, and placed near the base on the dorsal surface; metascutellum distinct; metapostnotum much reduced, hardly visible; propodeum completely chitinized and without a median suture; abdomen cylindrical; ninth tergite not especially large laterally; cerci distinct; sheath with the lower margin much thickened, the ventral surface sculptured and with some long hair; basitarsi distinctly shorter than the following joints; claws simple; intermediate tibiæ armed with a pair of spines at the apical third; posterior tibiæ armed with a single spine at the apical third; costal cell rather narrow; intercostal vein present; radial cell without a cross-vein or a distinct appendage, pointed at apex; three closed cubital cells; the second and third each receiving a recurrent near the base; basal vein joining the subcosta a short distance before the origin of the cubitus, longer than the first recurrent, therefore not parallel with it; first discoidal cell similar in outline to that of *Caloptilia*; nervulus received at about its length from the basal vein; anal vein complete, the first and second anal cells very much the same as in *Pseudosiobla*; radiellian cell without an appendage; one closed cubitellian cell; recurrentella wanting; anella wanting.

Zenarge turneri, sp. n.

Female.—Length 10 mm. Anterior margin of the clypeus arcuately emarginate medianly; supraclypeal area convex,

triangular in outline; median fovea rather large, deep, with sloping walls, nearly circular in outline; antennal furrows very poorly defined but present; ocellar basin shallow, rather large, triangular in outline but only poorly limited below; postocellar line distinctly shorter than the ocellocular line, subequal with the ocelloccipital line; postocellar furrow present; postocellar area poorly limited laterally, much wider than long; head shining, front with rather spare punctures; thorax shining, with small scattered punctures; stigma three times as long as wide, of nearly uniform width for basal two-thirds, then gradually tapering to metacarpus; third cubital cell narrowed above, the third intercubitus subequal in length with the third abscissa of the radius; abdomen shining; sheath seen from the side with the apex rounded. Black; clypeus, labrum, mandibles (except tips), face, inner orbits narrowly above antennæ, posterior orbits, margin (anterior, posterior, and lateral) of pronotum, tegulæ, apical two-thirds of scutellum, metascutellum, a broad band of mesoepisternum, and metepisternum yellowish white; abdomen ferruginous, propodeum and apical two tergites black; legs black, four anterior coxæ, trochanters, apices of femora, entire tibiæ, and tarsi yellowish white; hind coxæ except a large spot on upper lateral surface, trochanters, basal fourth of hind tibiæ, and four apical joints of hind tarsi yellowish white; wings subhyaline, venation including stigma dark brown.

Male.—Length 9 mm. Agrees very well with the characters given for the female; differs in colour from the female in having the mesosternum ferruginous, in having all of the black of the legs (except hind tibiæ and basitarsus) replaced by ferruginous; apex of abdomen black; tergites with distinct punctures which become so close on the basal segments that the surface is coriaceous; hypopygidium very deeply arcuately emarginate apically.

Type-locality. Killara, Sydney, N. S. Wales, Australia.

Described from two females (one type) and one male collected at an altitude of 400 feet on August 17, 1913, by R. E. Turner, after whom the species is named.

Type and allotype. British Museum (Natural History).

Paratype. U.S. Nat. Mus.

Genus ANCYLONEURA, Cameron.

The genus *Ancyloneura*, Cameron, belongs to the tribe Euriini, and falls close to *Neoeurys*, Rohwer, but may be

separated from the last-mentioned genus by the obsolete antennal furrows and by having the hind basitarsus shorter than the following joints.

The species which belong here have not been fully described, and seem to be closely related. The following key, which is based on literature, may aid in distinguishing the forms described:—

Key to the Species.

- | | |
|--|-----------------------------|
| Hind femora black; antennæ 15-jointed (Kirby's figure)..... | <i>nigripes</i> (Smith). |
| Hind femora reddish; antennæ with less than 15 joints | 1. |
| 1. Markings of the fore legs "sordid white"; antennæ 13-jointed. (Aru.) | <i>varipes</i> , Cameron. |
| Markings of the fore legs ferruginous; antennæ 12-jointed. (New Guinea.) | <i>wollastoni</i> , Rohwer. |

Ancyloneura wollastoni, sp. n.

In the absence of the first intercubitus this species differs from the recognized generic characters, but in all other ways it agrees with my notes and with the description.

Female.—Length 4.5 mm. Shining, without apparent sculpture; median fovea rather deep, elongate, linear; post-ocellar line slightly shorter than the ocelloccipital line; post-ocellar area not defined anteriorly and defined laterally by rather broad depressions; antennæ 12-jointed, the third joint slightly longer than the fourth and fifth; from the third joint the joints gradually decrease in length until the eleventh, which is subequal in length with the twelfth; eleventh joint a little more than twice as wide as long; stigma about three times as long as greatest width, angulate near base and tapering to a narrow apex; first intercubitus wanting; third cubital cell as long on the radius as the combined first and second; second recurrent about two-thirds the length of the second intercubitus from the base of the third cubital cell; sheath concealed; lower apical margin of lancets with regular rounded teeth. Black; apical part of femora (more extensively on posterior pair), anterior tibiæ, base of anterior tarsi, basal two-thirds of intermediate tibiæ, and basal half of hind tibiæ ferruginous; wings brown apically, hyaline basally; venation dark brown.

Type-locality. Iwaka River, New Guinea.

Described from one female, collected February 1911 by A. F. R. Wollaston.

Type. British Museum (Natural History).

Genus POLYCLONUS, Kirby.

In 'Genera Insectorum,' fasc. xxix. 1905, p. 40, Konow places the genus *Polyclonus*, Kirby, as a synonym of *Ancylo-neura*, Cameron. This seems to the author to be wrong, and as very little is known concerning the genus the following notes, taken from specimens in the British Museum, and made in 1909, may be of value:—

"A female of *Polyclonus atratus*, Kirby (genotype), from Melbourne, Victoria, 'C. F. 8. 00, No. 1164,' proves the genus is a good one. It may be briefly described thus: Length 5 mm.; expanse 12.5 mm. Clypeus truncate; malar space very narrow, practically wanting; antennal furrows indistinct but complete; a distinct furrow from the anterior ocellus to between bases of antennæ; head strongly granular; antennæ wanting beyond 12th joint, each joint beyond the second with a ramus like *Pterygophorus*; scutum and scutellum shining, sparsely punctured; tarsal claws simple; venation like *Perreyia* (fig. 80, plate 39, Proc. U.S. Nat. Mus. vol. 29, 1906), except that the third cubital receives the second recurrent and the third cubital cell is longer than the second. Black; labrum, mandibles, tibiæ, and tarsi pallid; wings hyaline, iridescent; venation black."

From these characters and others gained from an incomplete generic synopsis the author is of the opinion that the genus belongs to the tribe Euriini, where it is easily distinguished by the ramose antennæ of both sexes.

Neoeurys tasmanica, sp. n.

This new species is closely allied to *metallica*, but may be separated by narrower sheath, darker stigma, and shorter distance between the second recurrent and second intercubitus.

Female.—Length 5 mm. Antennal furrows complete to occiput; middle fovea shallow, wedge-shaped; postocellar furrow wanting; postocellar line subequal with the ocellular line; antennæ 13-jointed, the third joint but slightly longer than the fourth; scape but slightly longer than the pedicellum; sculpture of the head fine and close; stigma slightly angled at base, then regularly tapering to apex; second recurrent received by the third cubital cell half the length of the second intercubitus from the base of the cell; prescutum and scutum medianly finely granular and somewhat opaque; sides of the scutum and scutellum shining; mesepisternum with small rather close punctures; sheath

slightly concave above, rounded apically, and tapering to the rather narrow base. Blue-black, with a faint bronzy tinge to head; palpi, apices of anterior femora, and all of the tibiæ rufo-ferruginous; wings dusky hyaline, venation (including stigma) dark brown.

Male.—Length 3 mm. The male assigned here agrees closely; the middle fovea is somewhat deeper and the apices of all the femora are pale; the lower margin of the stigma is pale, and the second recurrent joins the third cubital cell somewhat further from the base. Hypopygidium narrow and truncate apically.

Type-locality. Tasmania.

Described from one female (type) collected on the summit of Mt. Wellington, 1904, by A. M. Lea, and one male (allotype) from Eaglehawk Neck, S.E. Tasmania, Feb. 12–Mar. 3, 1913, collected by R. E. Turner.

Type and allotype. Collection British Museum (Natural History).

XLIII.—*On some External Characters of Ruminant Artiodactyla*.—Part V. *The Tragelaphinæ*. By R. I. Pocock, F.R.S.

Subfamily TRAGELAPHINÆ.

The only fresh material available in 1910 for examination of the cutaneous glands of this group belonged to the genera *Tetraceros*, *Boselaphus*, and *Tragelaphus*. For the rest dependence had to be placed upon the inspection of dried skins and living examples, which yielded unsatisfactory results. Since that year additional material of those genera, as well as fresh examples of *Strepsiceros*, *Limnotragus*, and *Taurotragus*, have come into my hands, and these have enabled me to clear up some doubtful points.

Genus TETRACEROS, Leach.

Tetraceros quadricornis, Blainv. (p. 921).

I have nothing to add to my description of the glands of this species published in 1910, except to say that an adult female had the glands of the false hoofs of the hind legs as

well developed as in the male. Their secretion had a decidedly pungent and unpleasantly musteline odour.

The *rhinarium* is well developed and "bovine." From the anterior aspect the upper margin is strongly convex and the area beneath the nostrils is mesially grooved and very wide—wider, in fact, than the area above those orifices—and visible to a considerable extent in profile view. From the dorsal side the anterior margin is convexly truncated, and the posterior margin is straight between the posterior angles of the nostrils, the hair of the nose not extending forwards beyond that line.

Genus *BOSELAPHUS*, Blainv.

Boselaphus tragocamelus, Pall. (p. 926).

In a male example the *preorbital gland* had a much shallower pit than in the female described in 1910, and was without definite lids. The gland itself, moreover, was not regularly heart-shaped, but was longer than thick and of irregular form.

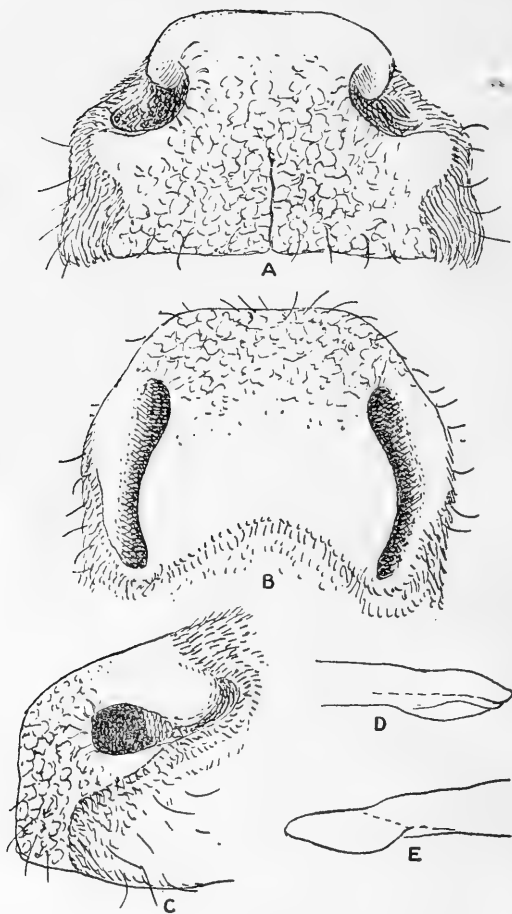
The *rhinarium* (fig. 1, A, B, C) is large and "bovine," closely resembling that of *Tetraceros*, but more protuberant in front, and, beneath the nostrils, laterally and with a wider internarial septum. On its dorsal side the hair advances a little way between the nostrils, so that the posterior border of the rhinarium is concave.

In 1910 I briefly described the glandular nature of the skin between the false hoofs of the hind feet in the female. The same feature is present in the male where the skin between the widely separated false hoofs is clothed with longish hair, is very thick and glandular, and mesially folded. In the fore foot there is no trace of the gland, the false hoofs being larger and the hair restricted to the narrow area between them. This gland (fig. 3, B) on the hind foot of *Boselaphus* clearly represents an earlier stage of the evolution of the pair of pouch-like glands present in *Tetraceros*. The presence of similar glands in *Taurotragus* and *Strepsiceros* (cf. *infra*) serves to link *Boselaphus* with the African Tragelaphines, and refutes, if refutation be needed, Rüttimeyer's claim that *Boselaphus* belongs to a different group.

Inguinal glands are absent and there are two pairs of *mammæ*.

The *penis* (fig. 1, D, E) agrees, generally speaking, with the sketch and description published by Gerhardt (*op. cit.*

Fig. 1.



- A. Rhinarium of *Boselaphus tragocamelus* from the front. $\times \frac{1}{3}$.
 B. The same from above.
 C. The same from below.
 D. The extremity of the penis of *B. tragocamelus* from below.
 E. The same from the left side.

p. 153). It ends in an elongated subovate portion defined by a shallow constriction. The urethral canal, however, reaches the extremity of this, lying rather upon its right than on its left side.

Genus TRAGELAPHUS, Blainv.

Tragelaphus scriptus, Pall., and its subspecies (p. 929).

The only specialized cutaneous glands which occur in this species and its numerous affiliated forms, of which *sylvaticus* is the commonest in our Zoological Gardens, are the *inguinals*, which, according to my examination of a large number of specimens, are invariably present as a pair of small pouches lying far out in front of the four teats, the orifice being in the fold between the thigh and the abdomen. The only other genera of Tragelaphines which possess these are *Limnotragus* and *Strepsiceros*. As in all the African Tragelaphines *preorbital* and *interdigital pedal glands* are absent. The glands between the false hoofs of the hind legs, found in *Tetraceros*, *Boselaphus*, *Strepsiceros*, and *Taurotragus* are also absent.

The *rhinarium* is variable with respect to the width of the area between the edge of the lower lip and the nostrils. Sometimes there is a definite narrow philtrum as in *Strepsiceros* and adult examples of *Taurotragus*, but not infrequently the hair of the upper lip does not encroach so far towards the middle line, leaving a broader irregularly shaped naked space. This variation may be a matter of age, or it may prove to have a racial significance. Otherwise the rhinarium seems to resemble that of *Taurotragus* and *Strepsiceros*, except that the posterior edge between the angles of the nostrils is straight from side to side.

The *penis*, as described and figured by Lönnberg (Ark. Zool. Stockholm, (5) v. no. 10, p. 7, fig. 6, 1909), is distally attenuated, with a terminal sigmoid flexure, the urethral canal not being prolonged beyond the tip of the glans penis.

Genus LIMNOTRAGUS, Scl. & Poc.*

Limnotragus spekei, Scl. (p. 930).

Examples of the two races *gratus* and *selousi* resemble

* Although this genus is of very doubtful value, it may be explained that, at the request of Mr. Thomas, who in 1900 was compelled by ill-health to abandon temporarily all zoological work, I took his place in the completion of vol. iv. of the 'Book of Antelopes.' Strictly speaking, therefore, although the matter is of no great moment, this generic name should be ascribed to Sclater and myself.

Tragelaphus with respect to the cutaneous glands, the inguinals being present and similarly placed and the glands between the false hoofs absent.

The *rhinarium* also is like that of *Tragelaphus*, except that the area between the nostrils and the edge of the lower lip is usually at all events wider. It is as wide as the inter-narial septum in a specimen of *selousi* and wider in an example of *gratus*. I have never seen it narrower, as is sometimes the case in *Tragelaphus*. *Limnotragus* appears merely to differ from *Tragelaphus* in the length of the hoofs and the nakedness of the posterior surface of the pastern and fetlock. But, as Meinertzhagen has pointed out (P. Z. S. 1916, i. p. 377), there is sometimes a patch of hair in the middle of the pastern between the false hoofs and the hoofs themselves. But in two examples which came together from the Congo to the Zoological Gardens the feet of the male were naked behind, while those of the female had the patch in question.

Genus STREPSICEROS, H. Smith.

Strepsiceros strepsiceros, Pall. (p. 931).

The fresh carcase of a hornless male, three or four months old, from South Africa, is all the material of this species I have seen.

The *rhinarium* has a narrow grooved philtrum and the hair upon the upperside of the nose spreads forwards some distance between the nostrils. Otherwise the *rhinarium* resembles that of *Tragelaphus*.

There is no trace of *preorbital gland*.

Inguinal glands also are absent. Possibly their absence in this specimen was due to immaturity, since both Owen and Ogilby agree as to their presence in the species. When present they probably resemble in size and position those of *S. imberbis*, of *Tragelaphus*, and *Limnotragus*.

Pedal glands of the interdigital type are absent, but upon the hind feet there are glands associated with the widely separated false hoofs as in *Taurotragus*. On the inner side of each false hoof there is a fringe of long black hair growing from a glandular thickening of the skin, the secretion of which is discharged amongst the roots of the hairs and into a hairless cleft between the thickening and the false hoof. The skin of the middle of the area between the false hoofs is clothed with short hair and is thin and not specially glan-

dular. On the fore feet no such fringes exist, the false hoofs being small, close together, and overlapping*.

Strepsiceros imberbis, Blyth.

Of this species I have seen one fresh specimen, an immature castrated male from Somaliland, and the feet and inguinal area of an adult female from British East Africa, kindly brought home for me by Mr. F. C. Selous.

These specimens resemble in nearly every particular the example of *S. strepsiceros*, above described. The upperside of the *rhinarium*, however, was not overgrown with hair to quite the same extent, and there was a single pair of inguinal glands, each consisting of a narrow sack 2 inches deep, with a small circular orifice, and lying far out in advance of the two pairs of mammae, as in *Tragelaphus* and *Limnotragus*.

The glands close to the false hoofs (fig. 3, D) of the hind feet were exactly as described in *S. strepsiceros*, and on the fore feet the false hoofs were smaller than on the hind feet and separated by a narrow strip of naked skin, horny in one of the specimens.

The penis of the castrated male was very small and simple, with a bluntly rounded termination. The urethral canal was not produced beyond the end of the glans.

Strepsiceros has hitherto been distinguished from *Tragelaphus* merely by small differences in the horns of very little systematic value. Particularly satisfactory, therefore, is the discovery of the difference between the two genera supplied by the glands adjoining the posterior false hoofs.

Genus TAUROTRAGUS, Wagn.

Taurotragus oryx, Pall. (p. 932).

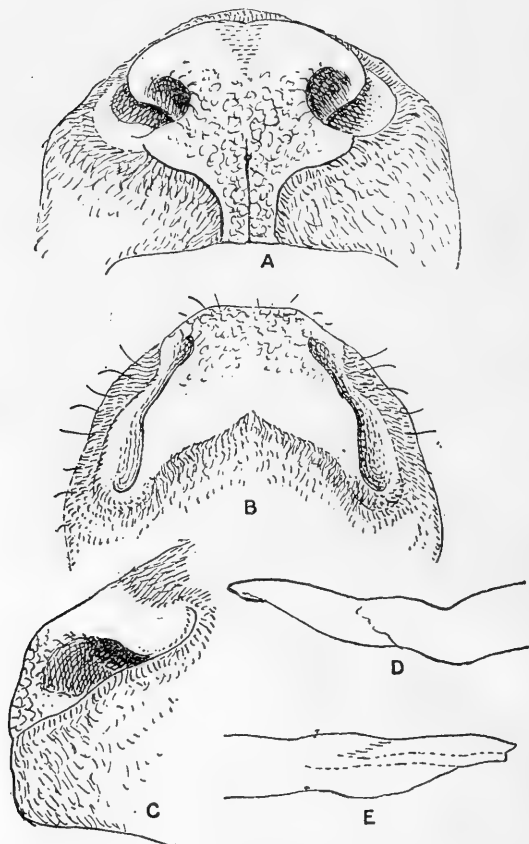
To the description of the cutaneous glands of this species published in 1910 I have to make one important addition. This is the presence of glands close to the false hoofs of the hind legs, precisely resembling those described above under *Strepsiceros*. These are as well developed in a calf one day old as in the adult, and they are the only specialized cutaneous glands present in the genus, so far as my observations go (fig. 3, A, C). I have never succeeded in finding a trace of the *preorbital gland* described by Mr. W. L. Sclater, and am compelled to disbelieve in its existence.

The *rhinarium* (fig. 2, A, B, C) in the adult is not "bovine,"

* *Nyala angasi* resembles *Strepsiceros* and differs from *Tragelaphus* in possessing the glandular fringes by the false hoofs of the hind legs.

like that of *Boselaphus*. It is much less protuberant both in front of and beneath the nostrils laterally, and the septum between the expanded nostrils is narrower. Beneath the nostrils in front the rhinarium spreads somewhat to right

Fig. 2.

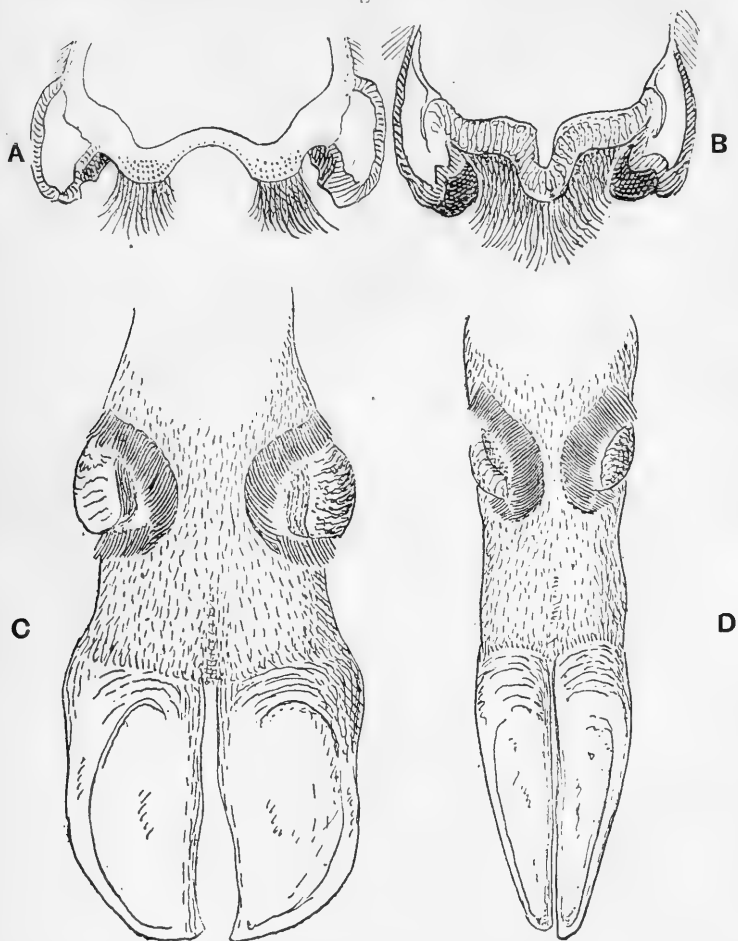


- A. Rhinarium of *Taurotragus oryx* from the front.
- B. The same from above.
- C. The same from the side.
- D. Extremity of penis of *T. oryx* from the left side.
- E. The same from below.

and left, being nearly as broad here as just above the nostrils; but beneath this it rapidly narrows to form a mesially grooved philtrum which is about as wide as half the internarial septum. The upper edge from the front view is

lightly convex; the posterior edge from above is lightly concave, the hairs of the upper side of the nose spreading

Fig. 3.



- A. Transverse section through the false hoofs and glands of the hind foot of *Taurotragus oryx*.
- B. The same of *Boselaphus tragocamelus*.
- C. Lower view of hind foot of *Taurotragus oryx*, showing the glandular fringes encircling the false hoofs on the inner side.
- D. The same of *Strepsiceros imberbis*.

forwards a little in advance of the posterior notch of the nostrils.

The width of the philtrum appears to vary sometimes

with age in an interesting manner. Thus in a calf one day old it is wider than in the adult, being about three-fourths the width of the internarial septum, whereas in a fœtus about three months developed the naked area beneath the nostrils is very broad, broader even than in the adult *Boselaphus*, giving the rhinarium a strictly bovine appearance. This suggests that the bovine type of rhinarium is the primitive type in the Ruminantia*.

As I recorded in 1910, *inguinal glands* and *interdigital pedal glands* are absent, but the hind feet possess glandular thickenings of the skin surmounted by a fringe of black hairs (fig. 3, A, C) precisely as in *Strepsiceros*.

The *penis* (fig. 2, D, E) of an old male has an elongated, undulating, attenuated terminal portion, much longer than in *Boselaphus*, and, as in that genus and others belonging to the Tragelaphinæ in which this organ has been described, the urethral canal is not produced beyond the tip of the glans.

The points of interest connected with the characters above enumerated may be summarized as follows:—

- | | |
|--|---|
| (1) Preorbital gland present | <i>Tetraceros, Boselaphus.</i> |
| " " absent | <i>Tragelaphus (Limnotragus), Nyala, Strepsiceros, Taurotragus.</i> |
| (2) Inguinal glands present | <i>Tragelaphus (Limnotragus), Strepsiceros</i>
(? always in the latter). |
| " " absent | <i>Tetraceros, Boselaphus, Taurotragus.</i> |
| (3) Glands between posterior false hoofs absent. | <i>Tragelaphus (Limnotragus).</i> |
| "Consisting" of definite "pockets" present. | |
| false hoofs | <i>Tetraceros.</i> |
| Consisting of a thickening of the skin only. | |
| Thickened skin extending across fetlock | <i>Boselaphus.</i> |
| Thickened skin restricted to area close to false hoofs and surmounted by fringe of hairs | <i>Nyala, Strepsiceros, Taurotragus.</i> |

* It may be added that in the fœtal specimen above alluded to the facial vibrissæ were well developed, consisting of short scattered mystacials and submentals, a row of superciliaries and suboculars, an upper and a lower genal tuft arising from the white spots on the cheek and interramals. It is singular that the Artiodactyla and the Carnivora are the only orders of mammals known to me which possess as a primitive character two genal tufts—an upper and a lower—on each cheek.

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No. 12. DECEMBER 1918.

XLIV.—*On some External Characters of Ruminant Artiodactyla.*—Part VI. *The Bovinæ.* By R. I. Pocock, F.R.S.

Subfamily *BOVINÆ*.

I retain this subfamily as a matter of convenience only, being unacquainted with a single character of importance by which it may be distinguished from the Tragelaphinæ. On the other hand, close affiliation between the two is attested by a large number of common characters. Indeed, *Anoa depressicornis*, the most primitive form of Bovinæ, quite commonly shows the typically Tragelaphine white spots and patches on the face, throat, and feet, which must be regarded as strong evidence of near affinity with the Tragelaphine stock, as I pointed out in 1910.

For close upon a century there has been great divergence of opinion regarding the status of the groups into which the species of the Bovinæ naturally fall. In 1827 Hamilton Smith split up the Linneæan genus *Bos* into a number of subgenera—*Bison*, *Bibos*, etc. By Gray, who added *Poephagus* to the series, these were granted generic rank. In this opinion he was followed by Rütimeyer, and more recently by Matschie. English authors, like Blanford, Flower, and Lydekker, on the contrary, retained the genus *Bos* in a comprehensive sense, giving subordinate rank to the others. In 1910 I followed that course, being unable to find evidence from the characters I was then working at for defining the

alleged genera and subgenera. Since that year, however, study of certain other external features—notably the rhinarium and penis—have supplied additional characters to those derived from the skull, horns, tail, distribution of hair, and outward form, which, I think, justify Gray's claim that the groups are worthy of generic recognition. Probably other characters bearing out this view will come to light with the examination of further material.

So far as the cutaneous glands are concerned, the genera have the following mainly negative features in common:—

Preorbital glands, as in all African Tragelaphines, are absent.

Inguinal glands are invariably absent, as in the Tragelaphine genera *Taurotragus*, *Boselaphus*, and *Tetraceros*.

Pedal glands of the interdigital type are also invariably absent, as in all Tragelaphines.

Glands on the false hoofs are absent, as in *Tragelaphus*.

Two pairs of *mammæ* are present, as in all Tragelaphines.

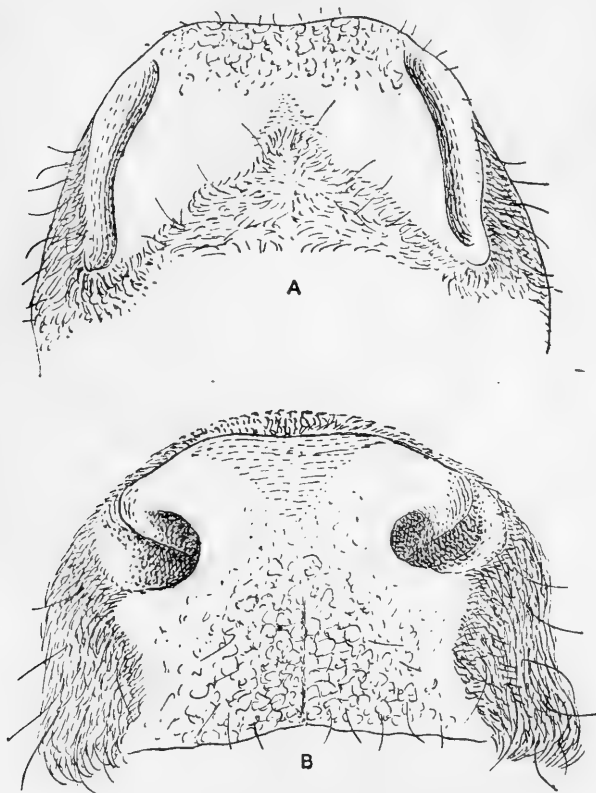
Genus *Bos*, Linn.

Bos, Linn. Syst. Nat. ed. 10, p. 1758: type, *taurus*.

Rhinarium (figs. 1, A, B; 3, C) large; viewed from the front its upper margin is evenly convex from side to side and the median area below the line of the widely separated expanded nostrils is wider than the internarial septum throughout its extent, the hairs of the upper lip extending inwards neither beneath the nostrils above nor along the edge of the upper lip below; above the edge of the lip there runs upwards a short shallow median groove, which is present in all genera, and thus disproves Lydekker's statement (Cat. Ung. in Brit. Mus. i. p. 11, 1912) that the rhinarium in the Bovinæ is undivided. A few scattered hairs arise from the rhinarium inferiorly, and its surface is sculptured and reticulated. The anterior portion of its dorsal surface is exposed to a varying degree in accordance with the extent to which the hair of the upper side of the muzzle spreads forwards between the nostrils; but the naked upper edge of the nostrils is always of considerable width and depth, and not narrowed as in *Bison* and *Poephagus*. The extension of the hair between the nostrils above varies according to the breed, being greater, for instance, in British park cattle (*B. taurus*) than in Indian humped cattle (*B. indicus*); but intergradation between these two forms seems to be supplied by other breeds of *B. taurus*.

The penis of *B. taurus*, as figured by Garrod (Proc. Zool. Soc. 1877, p. 10, fig. 19) is well known. It ends in an ovately rounded knob or cushion, on the lower side of which the orifice of the urethra terminates without running out into a definite tubular prolongation. In *B. indicus* (fig. 4, B, C) the penis is of a similar type.

Fig. 1.

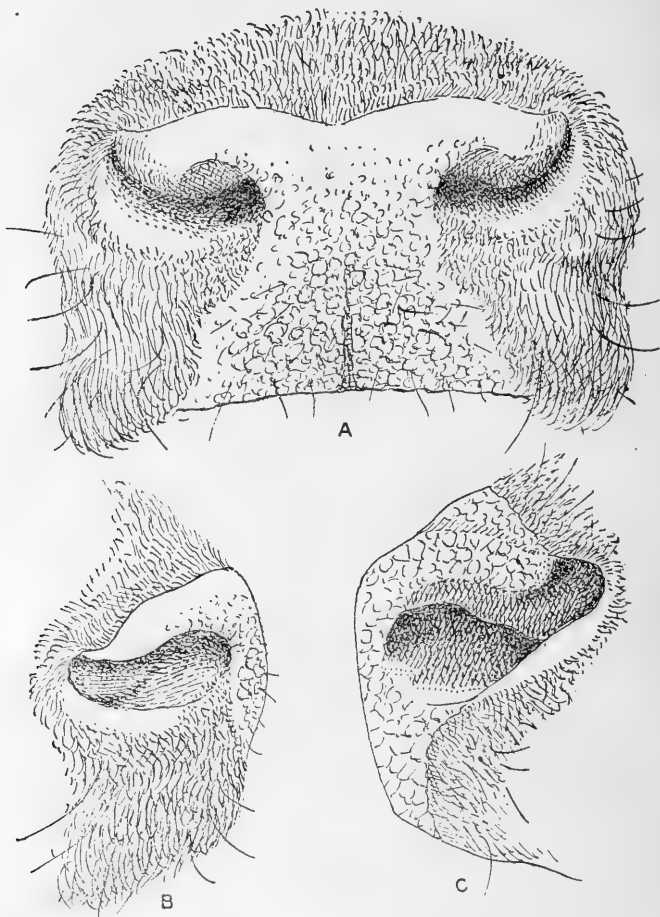


A. Rhinarium of zebu (*Bos indicus*) from above. $\times \frac{1}{3}$.
B. The same from the front.

The only existing members of this genus, as here recorded, are the numerous domesticated breeds of cattle referred to *B. taurus* and *B. indicus*. Apart from these there are a certain number of extinct species, of which the aurochs

(*B. primigenius*) is the best-known form. In domesticated cattle the skull is so variable in structure that it would

Fig. 2.



A. Rhinarium of American bison (*Bison bison*) from the front. $\times \frac{1}{3}$.

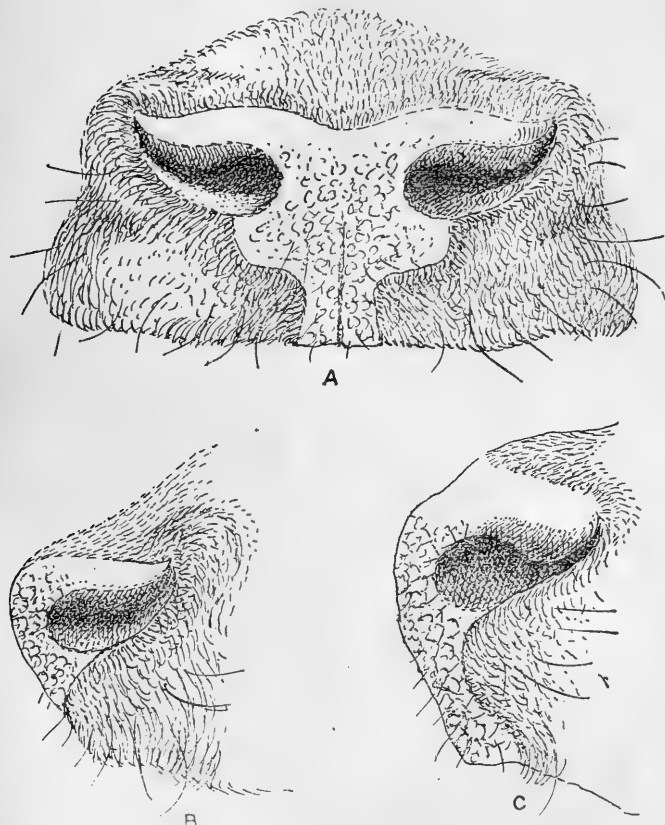
B. The same from the side.

C. The same of African buffalo (*Syncerus caffer aequinoctialis*) from the side.

require the examination of a long series of specimens to formulate a generic diagnosis based upon cranial characters.

But the success of such an undertaking would be doubtful, seeing that the skulls of some domesticated breeds differ more from aurochs-like breeds than the latter differ from other genera of Bovinæ. To this variability is probably to

Fig. 3.



- A. Rhinarium of yak (*Poephagus grunniens*) from the front. $\times \frac{1}{3}$.
B. The same from the side.
C. The same of zebu (*Bos indicus*). $\times \frac{1}{3}$.

be attributed in a great measure the prevalent admission of subgeneric rank to the groups into which the existing species of Bovinæ fall. The ears are no less variable in size and shape than the skull and horns, even in closely related breeds.

Genus BIBOS, Hodgson.

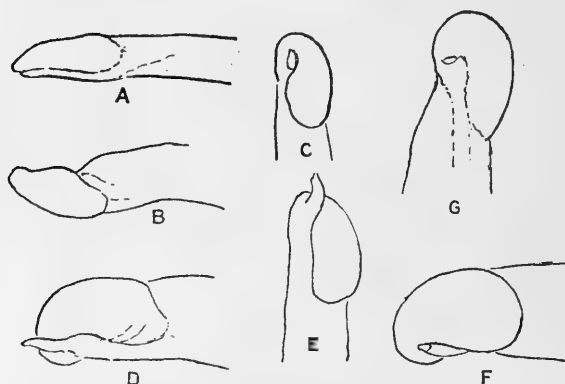
Bibos, Hodgson, Journ. Asiatic Soc. Bengal, vi. p. 499 (1837): type, *gaurus*, H. Smith.

Gavæus, Hodgson, op. cit. xvi. p. 706 (1847): type, *frontalis*.

Gauribos, *Uribos*, *Bubalibos*, Heude, Mém. Hist. Nat. Chin. v. pt. i. p. 3 (1901): types (now selected) respectively *laosiensis*, *platycerus*, *annamiticus*, Heude.

The *rhinarium* of the two forms I have examined—namely, *frontalis*, which is almost certainly a domesticated breed of *B. gaurus*, and *banteng*—does not differ in any important

Fig. 4.



- A. End of penis of African buffalo (*Syncerus caffer æquinoctialis?*) from the left side.
- B. The same of zebu (*Bos indicus*).
- C. The same from below.
- D. The same of banteng (*Bibos banteng*) from left side.
- E. The same of gayal (*Bibos frontalis*) from below.
- F. The same of American bison (*Bison bison*) from the side.
- G. The same from below.

respects from that of *Bos*, although the dorsal surface seems to be less overgrown with hair than even in *B. indicus*. The hair encroaches only to a slight extent between the posterior angles of the nostrils, so that the posterior border of the upper side is lightly concave. This feature may, however, prove to be variable. In the feet the interungual integument is naked as in *Bos*, not hairy as in *Bison*.

The *penis* (fig. 4, D, E) in both the above-mentioned species differs from that of *Bos* in that the urethral canal is

produced into a short tube free from the terminal cushion-like thickening of the glans, as in *Poepagus* (cf. *infra*).

Genus BISON, H. Smith.

Bison, H. Smith, Griffiths, An. King. v. p. 373 (1827): type, *bison*, Linn.

Bonassus, Wagner, Schreb. Säug., Suppl. iv. p. 515 (1844): type, *bonassus*, Linn.

The *rhinarium* (fig. 2, A, B) differs from that of *Bos* and *Bibos* in being more overgrown with hair both above and in front. In front the hair of the upper lip spreads towards the middle line along the lower margin of the nostrils and even penetrates the inner portion of those orifices. Hence at this level the *rhinarium* is not wider than the internarial septum. Inferiorly, however, it expands, and is broad where it passes into the edge of the upper lip. Dorsally the hair of the nose spreads over the upper surface of the *rhinarium* almost to its anterior margin, leaving a comparatively narrow naked rim bordering the nostrils above, so that from the anterior aspect the upper edge of the *rhinarium* does not present the evenly convex upper margin seen in *Bos* and *Bibos*.

The *feet* also differ from those of the two last-mentioned genera in having the interungual web overgrown with hair, which is sometimes stuck together with secretion. This hairy clothing has been observed in two pure-bred specimens, male and female, which died at different seasons of the year. Hence it may be inferred that the growth of hair on this part of the foot is not a seasonal character, as it appears to be in some of the Caprine Ruminants—e. g., *Ammotragus lervia* and *Ovis musimon**.

The *penis* (fig. 4, F, G), like that of *Bos*, has no free prolongation of the urethral canal.

Although I have cited *Bonassus* as a synonym of *Bison*, it must be explained that that course is justified mainly by inference, since I have had no opportunity of examining fresh material of the European species, *B. bonassus*, which is

* Some of the American bisons that have been imported into England as pure-bred stock appear from the higher carriage of the head, higher quarters, longer horns, and other points to have *taurus*-blood in their veins. They are hybrids known as cattaloes in the United States. One of these had the interungual integument of the hind feet naked as in *Bos taurus*, whereas the interungual skin of the fore feet was covered with a growth of short hairs, being intermediate in this respect between the naked condition seen in *B. taurus* and the long-haired condition seen in *Bison bison*.

a very distinct species from its American ally *B. bison*, and so far as external appearance is concerned, especially as regards the higher, flatter hind-quarters, serves to connect the type of *Bison* with *Bos*. Nothing is known of its feet or penis. Nevertheless, judging from living examples, the rhinarium seems to be shaped like that of *Bison bison*.

Genus POEPHAGUS, Gray.

Poephagus, Gray, List Mamm. Brit. Mus. p. 153 (1843); id. Cat. Ung. Brit. Mus. p. 39 (1852): type and only species, *grunniens*, Linn.

The *rhinarium* (fig. 3, A, B) is low and depressed and the whole of the upper surface is covered with short hair except for a comparatively narrow strip running along the upper margin of the nostrils. Beneath the inner edges of the nostrils in front the rhinarium is a little wider than the internarial septum, but the lower portion of its anterior surface is largely overgrown by the hairs of the upper lip, which encroach towards the middle line, leaving a median naked philtrum which is narrower than the internarial septum. In this last-mentioned particular the rhinarium of *Poephagus* differs from that of all other genera of Bovinæ.

The *penis*, as recorded by Lönnberg (Ark. Zool. Stockholm, (5) v. no. 10, 1909), has a short tubular urethral prolongation free from the terminal glandular thickening, apparently exactly as in *Bibos frontalis* and *banteng*.

Genus ANOA, H. Smith.

Anoa, H. Smith, Griffiths, Anim. King. v. pp. 355, 827, as subgenus of *Antelope*: type, *depressicornis*, H. Smith.

Bubalus, id. *op. cit.* p. 371: type, *bubalis* (= *bubalus*, Linn.).

Buffelus, Rütimeyer, Verb. Ges. Basel, (2) iv. p. 334 (1865): type, now selected, *bubalus*, Linn. (= *indicus*, Rött.).

Probubalus, id. *loc. cit.*: type *depressicornis* (= *celebensis*, Rött.).

The *rhinarium* of the two very distinct species I have examined—namely, *depressicornis* and *bubalis*—seems to resemble that of *Bos* and *Bibos* in all essential characters, exhibiting a large naked dorsal area and a nearly parallel-sided area below the level of the nostrils in front, which is wider than the internarial septum.

The *feet* have the interungual integument naked.

The *penis* I have not examined, but according to Lönnberg (Nova Acta Soc. Upsal. (3) xx. p. 60, pl. ii. fig. 16, 1903) there is no definite tubular urethral prolongation in *A. depressicornis*. His figure, nevertheless, suggests the presence

of a short urethral process. The statement, however, must be accepted in preference to the figure.

Genus SYNCERUS, Hodgson.

Syncerus, Hodgson, Journ. Asiat. Soc. Bengal, xvi. pt. 2, p. 709 (1847): type, *brachyceros*, Gray.

Planiceros, Gray, Cat. Rum. Brit. Mus. p. 10 (1872), as subgenus of *Bubalus*: type, *planiceros*, Blyth (= *centralis*, Gray).

Syncerus, id. op. cit. p. 12, as subgenus of *Bubalus*: type, *caffer*, Sparrm.

Apart from the shape of the head, horns, and the size of the ears, I am not acquainted with any important external characters by which the African buffaloes may be distinguished from their Asiatic allies. My examination, however, is restricted to one example—a young bull—of *S. caffer æquinoctialis*? In this specimen the *penis* was thinner than in other Bovines, and there was no trace of a tubular prolongation of the urethral canal free from the terminal thickening of the glans (fig. 4, A). A side view of the large *rhinarium* is shown in fig. 2, C.

Rütimeyer long ago pointed out some of the cranial differences between the African and Asiatic buffaloes, and, admitting them as distinct genera, adopted the name *Bubalus* for the former and introduced *Buffelus* for the latter. For no very good reasons, apparently, he severed the anoa (*A. depressicornis*) from the Asiatic forms and proposed *Probubalus* for its reception.

In 1901 Lönnberg (K. Svenska Vet.-Akad. Handl. xxxv. no. 3) adopted Rütimeyer's opinion as to the generic status of the two types of buffalo, and backed it by the addition of other cranial features. At the same time he showed that the anoa falls into line with the big buffaloes of India, the link between the two being supplied by *mindorensis*. He followed Rütimeyer also in the matter of nomenclature, with the exception that *Probubalus* lapsed as a synonym of *Buffelus*. Nevertheless, in 1903 (N. Acta Soc. Upsal. (3) xx. pp. 55–61) Lönnberg writes on the soft anatomy of *Anoa* as if it were a genus apart from other Asiatic buffaloes. The reason for this course is not clear.

In 1911 Hollister (P. Biol. Soc. Wash. xxiv. p. 191) adopted the views of Rütimeyer and Lönnberg regarding the buffaloes of Africa and India, without, however, being aware, so far as can be judged, of their publications upon this subject. Not possessing a skull of *depressicornis* for examination, he left *Anoa* alone, adopting the name *Bubalus* for

the Asiatic forms and *Syncerus* for the African. In this matter he was perfectly correct, if *Anoa* be left out of consideration. But if, as seems to be the case, *depressicornis* is not generically, or even subgenerically, distinguishable from *bubalis*, the name *Anoa* must supersede *Bubalus* for the Asiatic buffaloes by virtue of page priority.

In view of the distinguishing cranial characters between the African and Asiatic buffaloes pointed out by the above-quoted authors, it seems impossible to escape from the conclusion that the two groups deserve generic separation. From lack of material for examination I am unable to add any new external features to those that have been already published. Hollister's statement, however, that the ears of African buffaloes (*Syncerus*) are distinguished from those of Asiatic buffaloes (*Anoa*) by being heavily fringed is not always true. The ears, nevertheless, as I pointed out in 1912 ('Field,' Aug., p. 396), are very different in shape, those of the Asiatic buffaloes being narrower and much more pointed than of their African allies.

Setting aside the characters derived from the shape of the head, the horns, the height of the withers, the length and bushiness of the tail, the distribution of hair on the body, and others that have been made use of by previous workers who have adopted subgeneric or generic titles for the Bovine groups, the incidence of the external features to which attention has been particularly directed in this paper to support the generic recognition of these groups may be briefly summarized as follows:—

- (1) *a.* Rhinarium reduced inferiorly by the encroachment of the hair of the lower half of the upper lip to form a distinct philtrum which is narrower than the inter-narial septum; its upper surface overgrown with short hair up to the anterior margin, leaving a narrow naked rim above the nostrils. *Poephagus.*
- b.* Rhinarium very wide inferiorly above the edge of the upper lip, wider than the inter-narial septum, and forming no distinct philtrum; the hairs of the muzzle spreading inwards beneath the nostrils and entering the inner angles of those orifices, reducing the width of the rhinarium at this level; its upper surface covered with hair almost to the anterior edge, so that only a narrow naked rim borders the nostrils above. *Bison.*

- c. Rhinarium large and naked, everywhere wide below the level of the nostrils in front, its dorsal surface overgrown posteriorly between the nostrils to a varying extent, but never sufficiently to reduce the upper edge of the nostrils to a narrow naked rim *Bos, Bibos, Anoa, Syncerus.*
- (2) a. Feet with the interungual integument overgrown with hair..... *Bison.*
- b. Feet with the interungual integument naked *Bos, Bibos, Poepagus, Anoa, Syncerus.*
- (3) a. Penis with a short tubular urethral process free for a short distance from the terminal thickening of the glans..... *Bibos, Poepagus.*
- b. Penis without tubular urethral process .. *Bos, Bison, Anoa, Syncerus.*

XLV. — *Notes on Fossorial Hymenoptera*. — XXXVI. *On new African Philanthinæ*. By ROWLAND E. TURNER, F.Z.S., F.E.S.

Philanthus fossulatus, sp. n.

♀. Nigra; clypeo, mandibulis basi, scapo subtus, facie usque ad emarginationem oculorum, fronte macula, femoribus anticis subtus, femoribusque intermediis macula parva apicali flavis; pronoto margine postico, callis humeralibus, tegulis, mesopleuris antice, postscutello, tergito primo macula utrinque, secundo fascia obliqua utrinque, tertio, quarto quintoque fascia apicali, sexto macula magna utrinque, sternitis 3-5 fascia undulata antice bisinuata, secundo fascia lata postice emarginata, sexto fere toto, tibiis tarsisque albidis; flagello, coxis, trochanteribus, femoribus, segmentis abdominalibus primo, secundo, sextoque, tertio apice quintoque basi ferrugineis; alis hyalinis, venis fuscis, stigmatibus costaque testaceis.

Long. 10 mm.

♀. Clypeus very broadly rounded anteriorly, with a few scattered and shallow punctures; antennæ inserted nearer to the eyes than to each other, the front between them distinctly swollen. Front very closely and finely punctured-rugulose, the vertex much more strongly punctured. Antennæ not very stout; second joint of the flagellum slender at the base, gradually thickened to the apex, about

as long as the third and fourth joints combined, third joint a little broader at the apex than long. Ocelli in a broad triangle, the posterior pair fully half as far again from each other as from the eyes. Pronotum as broad as the mesonotum, smooth and shining, the mesonotum shining, with large and rather sparse punctures; scutellum and post-scutellum shining, the former with a few small punctures. Tergites shining, rather closely covered with large and very deep punctures, on the fourth tergite the punctures become sparser and shallow at the apex, those on the fifth tergite are small and scattered, sixth tergite almost smooth; sternites shallowly and sparsely punctured. Median segment finely and closely punctured; the basal triangular area large, covering almost all the dorsal surface, smooth and shining with a well-marked median sulcus and without marginal carinæ. Cubitus of the hind wing interstitial with the transverse median nervure, the fore wings with a small fuscous cloud at the extreme apex.

Hab. Bohotle, Somaliland (*A. F. Appleton*).

Easily distinguished by the very coarse puncturation of the tergites. Nearly allied to the group of *P. venustus*, Rossi.

Philanthus flagellarius, sp. n.

♀. Nigra; manibulis, apice excepto, clypeo, facie infra antennis tegulisque macula basali pallide flavis; tibiis tarsisque anticis femoribusque anticis infra flavo-testaceis; tibiis tarsisque intermediis posticisque, femoribusque intermediis posticisque apice extremo testaceis; abdomine rufo-testaceo, basi flavescente; alis fusco-hyalinis, venis nigris, stigmatibus testaceo; antennis crassissimis.

Long. 12 mm.

♀. Clypeus rounded at the apex, shining, shallowly and very sparsely punctured; front very finely and closely longitudinally rugulose, vertex punctured, the punctures more or less confluent transversely; posterior ocelli as far from each other as from the eyes. Antennæ very stout; second joint of the flagellum rapidly broadened from the base, almost as broad at the apex as long, scarcely longer than the third joint; the third to tenth joints broader than long. Mesonotum and mesopleuræ closely and rather coarsely punctured, scutellum and postscutellum more closely and finely punctured; median segment irregularly rugulose on the sides and on the apical slope; the triangular dorsal area rugose, margined by distinct grooves. The two

basal tergites subopaque, without distinct punctures; the apical tergites shining, with a few small and scattered punctures; sternites shining, sparsely but more strongly punctured; the second sternite smooth, except at the apex. Cubitus of the hind wing originating just beyond the transverse median nervure.

Hab. Usangu District, German East Africa, 3500 to 4500 ft. (*S. A. Neave*), December; Lilongwe District, Central Angoniland, 4000 to 5000 ft. (*S. A. Neave*), May 28–June 2, 1910.

Somewhat resembles *P. dolosus*, Kohl, but is easily distinguished by the very stout flagellum and the sculpture of the scutellum and median segment.

Philanthus fuscipennis, Guér.

Philanthus fuscipennis, Guér. Iconogr. regn. anim. iii., Insect. p. 443 (1845).

Philanthus consimilis, Kohl, Ann. Naturh. Hofmus. Wien, vi. p. 349 (1891). ♂ ♀.

Philanthus reticulatus, Cameron, Sjöstedt, Kilimandjaro-Meru Exp., Zool. ii. p. 270 (1910).

Hab. The whole Ethiopian region.

A very variable species in colour; the yellow markings on the scutellum and postscutellum are usually obsolete, as in Guérin's description.

Philanthus nigrohirtus, sp. n.

♀. Nigra, mandibulis macula basali, clypeo, facie, macula parva pone oculos, vertice macula obliqua utrinque oculos attingente, pronoto margine postico, tegulis, callis humeralibus macula parva, mesopleuris antice, scutello, postscutello, femoribus anticis intus, tibiisque supra flavis; abdomine fulvo-flavidulo, segmento primo basi nigro; fronte inter antennas dense nigro-hirsuto; alis fuscis.

♂. Feminae similis; fronte supra antennis bimaculata (saepe transverse fasciata), vertice immaculato, scutello postscutelloque nigris, nonnunquam flavo-maculatis, clypeo apice macula minuta nigra.

Long., ♀ 12 mm., ♂ 10 mm.

♀. Clypeus very broadly rounded at the apex, very sparsely punctured, with a long black hair springing from each puncture; front very closely and finely punctured, with delicate longitudinal striæ, and rather thickly clothed with long black hairs, which are especially dense between the antennæ; vertex shining, rather closely punctured; the

ocelli in an almost equilateral triangle, the posterior pair almost as far from each other as from the eyes. Antennæ stout, the second joint of the flagellum not as long as the third and fourth combined, the fourth as broad as long. Pronotum smooth; mesonotum shining, closely punctured, more closely anteriorly than posteriorly, clothed with black hairs; scutellum and postscutellum almost smooth, pleuræ closely punctured. Median segment closely and finely punctured, the sulci defining the basal area almost obsolete, a broad longitudinal depression on the middle of the dorsal surface not quite extending to the base. Abdomen smooth and shining, sixth tergite delicately longitudinally striated; sternites sparsely punctured. Fore metatarsus with seven spines. Cubitus of the hind wing originating distinctly beyond the transverse median nervure.

♂. The sculpture throughout rather stronger than in the female, scutellum sparsely punctured, median segment finely punctured-rugose; tergites smooth and shining, the seventh tergite with large scattered punctures. Fourth joint of the flagellum distinctly longer than broad. Distance between the eyes on the vertex about equal to the length of flagellar joints 2-4.

Hab. Mt. Kokanjero, S.W. of Elgon, Uganda Protectorate, 6400 ft. (*S. A. Neave*), August 1911; Ruwenzori, 7000-8000 ft. (*Scott Elliot*).

Males with the black pubescence somewhat shorter are in the collection from Ankole-Toro Border, E. of Lake George (*S. A. Neave*), October 1911; Nandi Escarpment, 5800 ft. (*S. A. Neave*), May 1911; and Uchwezi Forest, British E. Africa (*S. A. Neave*), March 1912.

Philanthus nigrohirtus, subsp. *calvus*, subsp. n.

Specimens of both sexes from the Luangwa Valley, N.E. Rhodesia, are without the long black hairs on the head and thorax, but do not differ appreciably otherwise. For this form I suggest the above subspecific name. The female is without yellow marks on the vertex. This approaches *P. stecki*, Schulz, but the eyes are a little further apart on the vertex, the posterior ocelli in *stecki* being distinctly nearer to the eyes than to each other. Specimens apparently not distinct specifically from *calvus* from W. Africa (Gambia, Gold Coast, Togo, and N. Nigeria) often have eight spines on the fore metatarsus. These seem to be distinct from *P. camerunensis*, Tullgr., in which the posterior

ocelli are much further from the eyes than from each other and the clypeus more narrowly rounded.

Philanthus loeflingii, Dahlb.

Philanthus loeflingii, Dahlb. Hymen. Europ. i. p. 495 (1845). ♀.

Philanthus inominatus, Bingh. Ann. & Mag. Hist. (8) x. p. 212 (1902).

Hab. The whole Ethiopian region from Harar and the Gambia to Natal.

Philanthus triangulum, Fabr.

Vespa triangulum, Fabr. Entom. Syst. p. 373 (1775).

Crabro diadema, Fabr. Spec. Intect. i. p. 471 (1781).

Philanthus frontalis, Gerst. Monatsber. Akad. Wiss. Berlin, p. 509 (1857).

Hab. The whole Ethiopian region.

Philanthus histrio, Fabr.

Philanthus histrio, Fabr. Syst. Piez. p. 301 (1804).

Philanthus formosus, Sm. Cat. Hym. B.M. iv. p. 471 (1856). ♂.

Philanthus flavolineatus, Cameron, Sjöstedt, Kilimandjaro-Meru Exp., Zool. ii. p. 271 (1910).

Philanthus trichocephalus, Cam. Ann. Transvaal Mus. ii. p. 146 (1910).

Hab. E. Africa from Harar to Natal; Angola.

Philanthus ugandicus, Magr.

Philanthus ugandicus, Magr. Bull. Mus. Hist. Nat. Paris, xiv. p. 188 (1908). ♀.

Philanthus pilifrons, Cameron, Sjöstedt, Kilimandjaro-Meru Exp., Zool. ii. p. 271 (1910). ♂.

Hab. E. Africa, Transvaal to Harar.

I think that these, although differing much in colour, are only sexes of one species; but in specimens from Mombasa the males are coloured as the females, with the abdomen wholly testaceous red on the second and third tergites and a yellow spot on each side of the first tergite, the fourth and fifth tergites are marked with black at the base. This appears to be the usual colouring of the species from Harar to Johannesburg. I have seen no females with the colouring of *P. pilifrons*, but several males from the Nandi plateau and Usanga. *Philanthus limatus*, Bingh., is allied to this species, but not identical.

Philanthus strigulosus, sp. n.

♀. Nigra; clypeo, facie, macula curvata inter antennis, fascia transversa frontali, orbitis externis anguste tegulisque flavis; tergitis primo macula magna utrinque, secundo, apice excepto, tertioque lateribus fulvo-ferrugineis; tergitis quarto quintoque lateribus anguste, sternitis 2-5, basi nigris, femoribus posticis apice, anticis intermediisque fere totis, tibiis tarsisque flavo-testaceis; alis flavo-hyalinis, apice leviter infuscatis, venis fulvis.

♂. Feminae similis; fascia frontali latissima; tergito quarto etiam fulvo-ferrugineo, apice in medio nigro, sexto lateribus flavo-maculato.

Long., ♀ 18 mm., ♂ 17 mm.

♀. Clypeus broadly rounded anteriorly, sparsely and shallowly punctured; front between the antennae convex, very finely and closely punctured, the front above the antennae very finely and closely longitudinally striated, punctured between the striae; vertex shining, coarsely, but not closely punctured; ocelli in a broad triangle, the posterior pair a little further from the eyes than from each other; pubescence dark fulvous on the front, black on the vertex and thorax; second joint of the flagellum as long as the third and fourth combined, each of the two latter a little longer than broad. Pronotum closely punctured; mesonotum closely and strongly punctured anteriorly, much more sparsely in the middle and at the apex; scutellum shining, coarsely but sparsely punctured; postscutellum more closely punctured. Triangular area of the median segment very coarsely obliquely striate-rugose, margined by a very broad smooth and shining space; the sides and apex of the segment very closely, but not coarsely, punctured rugulose. Tergites rather sparsely punctured; the sixth tergite very delicately longitudinally striolate towards the apex; sternites with very sparse large punctures. Basal joint of the fore tarsi with eight spines on the outer margin. Cubitus of the hind wing originating a little beyond the transverse median nervure.

♂. Clypeus, face, vertex, mesonotum, and scutellum much more closely punctured than in the female. A bunch of long black hairs springing from just above the base of the mandibles on each side and reaching more than halfway to the middle of the margin of the clypeus. The two basal tergites more closely punctured than the others; seventh tergite coarsely but sparsely punctured.

Hab. Near Johannesburg, Transvaal (*A. J. Chalmers*);

Basutoland, between Matsekuwa and Mafeteng (*R. Crawshay*), March 30, 1902.

In the sculpture this approaches *P. rugosus*, Kohl, which I have not seen, but is a larger species, very differently coloured. There are only seven spines on the fore tarsus of the female in *rugosus*, instead of eight, and the clypeus of the male *rugosus* is armed with three small teeth, which are absent in *strigulosus*. There is also no mention in Kohl's description of the tufts of long hairs near the base of the mandibles. The puncturation of the second and third tergites of the female is as close as on the first, though the punctures are smaller.

Cerceris bagandarum, sp. n.

♀. Nigra; capite ferrugineo, fascia lata frontali nigra; clypeo, facie, carina interantennali, tergisque primo, basi nigro, secundoque flavis; pronoto, mesonoto lateribus anguste, tegulis, pleuris, scutello, postscutello, segmento mediano, tergito sexto basi, sternitis primo dimidio apicali, sextoque, pedibusque ferrugineis; coxis supra, femoribusque posticis supra nigris; alis flavo-hyalinis, apice late infuscatis, venis testaceis; clypeo apice porrecto; mesopleuris subtuberculatis; sternito secundo area elevata basali nulla.

♂. Feminae similis; pleuris nigris, segmento mediano nigro macula magna ferruginea utrinque, sternitis secundo, sexto, septimoque, tergisque sexto septimoque ferrugineis; tergitis tertio, quarto quintoque fascia angusta transversa angulis apicalibus flava; alis subhyalinis, haud flavescens; clypeo haud porrecto apice angustato et obtuse tridentato; mesopleuris haud tuberculatis.

Long., ♀ 16 mm., ♂ 11 mm.

♀. Mandibles with a large triangular tooth on the inner margin at about one-third from the apex. Clypeus gradually raised from near the base, strongly convex and porrect at the apex, but without a free lamina. Antennae inserted about half as far again from the anterior ocellus as from the base of the clypeus; interantennal carina strong; second joint of flagellum about two and a half times as long as the first. Posterior ocelli nearly twice as far from the eyes as from each other and as far from the hind margin of the head as from the eyes. Clypeus and face subopaque almost impunctate, front and vertex closely punctured-rugose; thorax and median segment more coarsely punctured-rugose; mesopleuræ with a small tubercle; triangular basal area of the median segment strongly and regularly

transversely striate, the stræ very feebly arched. Abdomen almost smooth, finely aciculate, the basal segment distinctly broader than long, with a few scattered punctures; sixth tergite strongly narrowed from the base to near the middle, thence narrowly produced with almost parallel sides and narrowly rounded at the apex. Sixth sternite deeply triangularly emarginate at the apex, with tufts of golden hairs springing from just beneath the apical angles, the sixth tergite margined laterally with golden hairs, springing from beneath the segment.

♂. Mandibles with a blunt ill-defined tooth near the middle of the inner margin; clypeus and front minutely punctured, sparsely clothed with short sericeous pubescence; the clypeus longer than broad, narrowed anteriorly, the apical margin with three obtuse teeth. Antennæ inserted nearly as far from the base of the clypeus as from the anterior ocellus; second joint of the flagellum twice as long as the first. First tergite broader than long; sixth sternite with an acute spine and a tuft of long golden hairs at the apical angles; seventh sternite shallowly emarginate at the apex; seventh tergite parallel-sided, truncate at the apex, half as long again as broad.

Hab. Kafu River, near Hoima-Kampala Road, Uganda Protectorate, 3500 ft. (*S. A. Neave*), December 29–31, 1911, 2 ♀ ♀; Siroko River, near W. foot of Mt. Elgon, 3600 ft. Uganda Protectorate (*S. A. Neave*), Aug. 12–14, 1911, 1 ♂.

Very near *C. diodonta*, Schlett., though differing much in colour. The structural points in both sexes correspond closely, but the striation of the basal area of the median segment is more oblique in *diodonta* and the puncturation of the second tergite is quite distinct, not obsolete as in the present species; the second tergite is also broader in *diodonta*, being rather sharply broadened just behind the base.

Cerceris sodalis, sp. n.

♀ ♂. Very close to *C. bagandarum* and practically identical with that species in the structure, colour, and sculpture of the head, thorax, and median segment, the female, however, has the posterior margin of the pronotum and the post-scutellum yellow. The colour of the abdomen is ferruginous in both sexes, the sternites at the base and the middle of the second tergite black; the first tergite with a narrow apical band, second very broadly at the sides and narrowly at the apex, tergites 3–5 in the female and 3–6 in the male rather

less broadly at the sides and narrowly at the apex yellow. The sixth tergite of the female is very narrow at the apex, more so than in *bagandarum*, and the second tergite is more distinctly punctured in both sexes than in that species, though less closely than in *diodonta*. The second tergite of the female is broader than in *bagandarum*, though scarcely as broad as in *diodonta*.

Hab. 30 miles from Magadi Junction, British E. Africa (*F. G. Hamilton*), May 1912; Marsabit, British E. Africa (*C. A. Neave*), October 1911; east shore of Victoria Nyanza, near Karungu (*S. A. Neave*), April 1911; Kibwezi, British E. Africa, 3000 ft. (*S. A. Neave*), April 1911.

It is quite possible that this and *bagandarum* may prove to be a subspecies of *diodonta*, but they are quite easily distinguished, and until large collections are available may conveniently stand as distinct species. *C. severini*, Kohl, is also very near in structure.

Cerceris bicolor, Sm.

Cerceris bicolor, Sm. Cat. Hym. B.M. iv. p. 447, no. 52 (1856). ♀.

Cerceris fossor, Sm. Cat. Hym. B.M. iv. p. 447, no. 54 (1856). ♂.

Cerceris andersoni, sp. n.

♀. Nigra; mandibulis, apice excepto, flagello, articulis apicalibus supra infumatis, tegulis, segmento abdominali sexto, pedibusque, coxis exceptis, ferrugineis; clypei lamina macula magna, carina inter antennis ad clypei basin, facie fascia lata longitudinali utrinque, postscutello, tergitis primo, tertio, quarto quintoque fascia angusta apicali, sternitoque tertio macula transversa apicali utrinque flavis; alis sordide hyalinis, apice cellulaque radiali infuscatis, venis fuscis, stigmate testaceo; clypeo lamina porrecta libera; mesopleuris haud tuberculatis; sternito secundo area basali elevata nulla.

Long. 10 mm.

♀. Clypeus with a porrect lamina, free from near the base, the lamina coarsely punctured at the sides, the apical margin very shallowly and broadly emarginate and nearly equal to the distance from the base of the clypeus to the apex of the lamina; the clypeus below the lamina smooth and shining, truncate at the apex. Antennæ inserted about twice as far from the anterior ocellus as from the base of the clypeus, the second joint of the flagellum less than half as long again as the third. Inner orbits of the eyes almost parallel; posterior ocelli further from the eyes than from each other. Face sparsely punctured; head and thorax

very closely rugosely punctured, the postscutellum more sparsely punctured; pronotum about two-thirds as long as the scutellum. Median segment rugosely punctured; the basal area triangular, almost equilateral, obliquely striated, with a median longitudinal groove, the apex irregularly transversely striated. Tergites strongly but not closely punctured, first tergite broader at the apex than long; pygidial area rugulose, elongate, fully twice as long as its greatest breadth, and more than three times as long as its apical breadth, the apex subtruncate. Second sternite shining, sparsely punctured.

Hab. Eastern edge of forest of Aberdare Mountains, 7300 ft. (*T. J. Anderson*), February 1911.

This belongs to the group of the European *C. labiata*, and is rather closely related to that species, but is not very near any other Ethiopian species. The interantennal carina is less elevated than in *labiata*, and is flattened towards the base of the clypeus. Two females from Mlanje Plateau, Nyasaland, 6500 ft. (*S. A. Neave*), December 1912, have the postscutellum black and the lamina of the clypeus much reduced in size. These may represent a subspecies, but I cannot regard them as specifically distinct.

XLVI.—*A new Dinosaur from the Stormberg Beds of South Africa.* By S. H. HAUGHTON, B.A., F.G.S., Assistant Director, South African Museum.

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Thecodontosaurus minor, sp. n.

The specimens forming the type of this new form were presented to the South African Museum by the late Dr. M. Ricono. They consist of a left tibia, a cervical vertebra, and a portion of the left ilium.

Left Tibia.—The tibia is 109 mm. long. The proximal articular surface is 31 mm. long and 18 mm. broad. This surface for the most part slopes obliquely backwards and laterally, the inner border being convex from front to back and higher in front than behind. The tuberositas-tibiæ is almost the highest point of the bone; it is prolonged anteriorly and turned slightly outwards. The lateral condyle is

strongly developed. Below the head the shaft thins rapidly until at its middle it has an antero-posterior thickness of 12 mm. and a width of 10 mm. Thence it thickens towards the distal end. The anterior face is flat, with a prominent edge on the lateral side and a rounded edge medially. The outer sharp edge is continued down to the anterior distal process. The posterior border of the shaft is rounded.

The distal surface is trapezoidal in form. The inner anterior border is 20.5 mm. long, the posterior outer border 16 mm. long, while the posterior inner border is 12 mm. long. The anterior process lies 7 mm. above the posterior process. Between the two on the outer surface of the bone is a shallow groove.

Cervical Vertebra.—The length of the body is 31 mm. The anterior articular surface is slightly larger than the posterior. Both are considerably higher than broad. The body is pronouncedly amphicœlous. There is a prominent median ventral keel, sharper in its anterior half. The whole body is strongly compressed laterally, having a width at the middle of 5 mm. and at the anterior end of 8 mm. The canal has a height and breadth anteriorly each of 5 mm. The ends of the zygapophyses are missing. The dorsal spine was low and fairly long, with a somewhat convex upper border.

Ischium.—A portion of what is probably the left ischium is preserved, including the proximal articular surface. The bone is bent strongly backwards, more so than in *Thecodontosaurus antiquus* as figured by von Huene, so that the ischium must have been directed very strongly backwards. At the broken distal end the bone is 12 mm. thick and 6.5 mm. broad. The inner border of the proximal surface is straight, the lateral border has a prominent outward projection, the maximum width of the surface being 9 mm.

The nature of the tibia and the ischium mark these remains off from the Plateosauridæ, and place them among the Thecodontosauridæ. They indicate a member of this family smaller than any hitherto described from South Africa, and which cannot be exactly identified with any European species. I propose, therefore, to give it a new specific name, *Thecodontosaurus minor*.

Type. S.A.M. Cat. no. 3451.

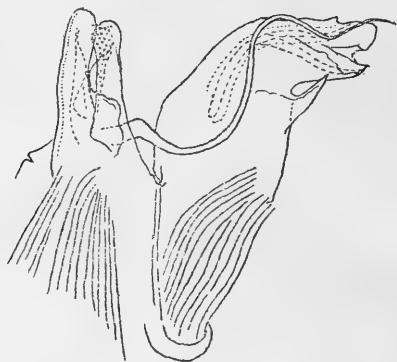
Locality. Pitsing, Maclear, C.P. Cutting in road to Naude's Nek.

Horizon. Red Beds, just below halfway from base.

XLVII.—*Notes on Myriapoda.*—XIV. *The Re-discovery of Cyldroiulus parisiorum (Brölemann et Verhoeff)*. By HILDA K. BRADE-BIRKS, M.Sc., M.B., Ch.B., L.R.C.P., M.R.C.S., and the Rev. S. GRAHAM BRADE-BIRKS, M.Sc.

WE hope to deal before very long with some centipede and millipede material from the English Midlands, but we think the present brief note advisable, owing to the exceptional interest of the species it records.

Mr. S. Priest, F.G.S., with Mr. and Mrs. F. J. Epps (all members of the Dartford Naturalists' Field Club) visited Upper Arley, Worcestershire, on 22. vii. 1918, and took a number of millipedes and centipedes between the bark and trunk of fallen timber in a meadow next to the churchyard there. This material, which was kindly submitted to us by the collectors, included a species of *Julus* (s. l.), which upon dissection we found to be referable to *Cyldroiulus parisiorum* (Brölemann et Verhoeff, 1896).



Anterior and posterior gonopods in profile. $\times 100$. H. K. B.-B. del.

We sent our drawing of the gonopods to M. le Dr. Henry W. Brölemann, who agrees with our diagnosis, and informs us, *in litt.*, that nobody appears to have identified the species since its first description (1). Thus some doubt had arisen in Dr. Brölemann's mind as to the validity of the species. The English rediscovery of the animal is therefore of some importance.

Externally *C. parisiorum* is practically indistinguishable

from *C. britannicus*, Verhoeff, and *C. frisius*, Verhoeff, both of which are not uncommon English species. However, the gonopods, which are figured by Brölemann and Verhoeff (*loc. cit.*), are quite definite diagnostic characters, and so there is no doubt about the record. Our material bears these numbers:—1379, 1380, 1381, 1382, Brade-Birks collection.

REFERENCE.

- (1) BRÖLEMANN, H. W., and C. W. VERHOEFF. "Matériaux pour servir à une faune des Myriapodes de France." Feuille des Jeunes Naturalistes, Sept. 1896, no. 311, pp. 214 *et seq.*, with 10 text-figs.
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XLVIII.—Note on the Pectoral Fin of *Eusthenopteron*.

By Dr. BRANISLAV PETRONIEVICS.

THE pectoral fin of *Eusthenopteron* was figured and described for the first time by Whiteaves (comp. J. F. Whiteaves, 1889, p. 87, & pl. v. fig. 5), whose description was improved by Traquair (comp. R. H. Traquair, 1890, p. 19). Two other specimens of the same fin were figured by A. S. Woodward (1898, p. 25) and W. Patten (1912, p. 391).

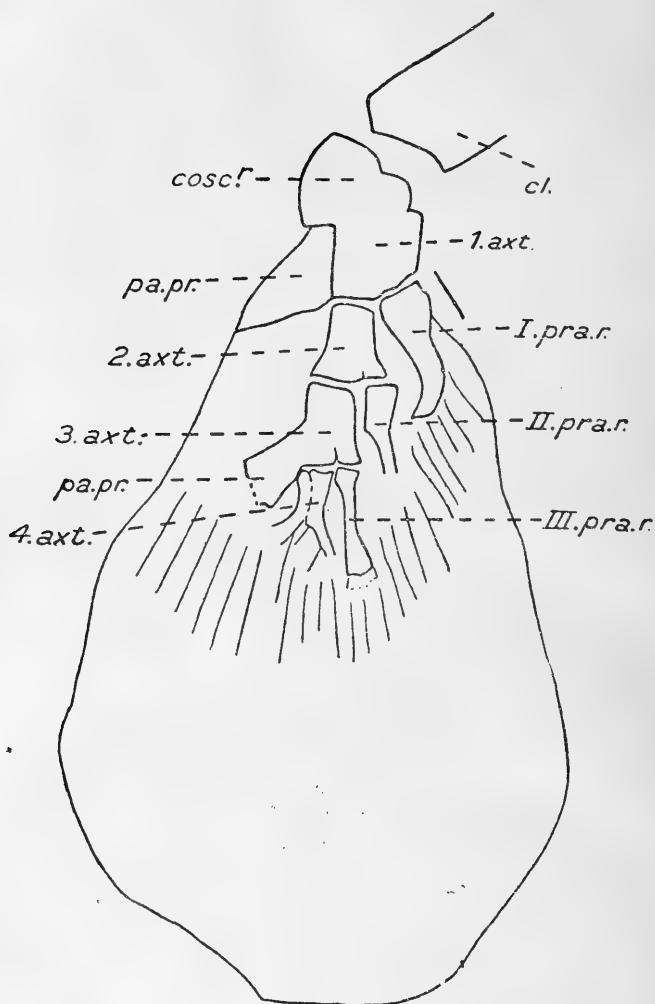
During my stay in London this year the pectoral fin in the British Museum specimen P. 6796 of *Eusthenopteron*, figured by A. S. Woodward (whose figure was republished by E. S. Goodrich in 1902, pl. xvi. fig. 1), was somewhat newly prepared by Mr. F. O. Barlow. I give here a new figure of it (comp. text-fig. 1) and a brief description.

The pectoral fin in our specimen is composed (1) of an axis, (2) of preaxial radials, and (3) of postaxial processes.

The axis consists of four pieces. The first or basal piece is situated behind the displaced cleithrum, of which the inferior edge lies near to its superior edge in the specimen. It is not possible to decide whether this elongated and somewhat obscure bony matter is to be identified wholly with the basal piece of the fin, or whether it does not comprise also the coraco-scapular ossification. Should this latter be the case, then the front edge of the postradial process of the basal would mark the limit between the basal and coraco-scapula.

The second piece of the axis is expanded and slightly bifurcated posteriorly. The third piece is somewhat longer than the second and expanded still more posteriorly, where it has not only a large postaxial process, but is also more distinctly bifurcated.

Fig. 1.



Pectoral Fin of *Eusthenopteron*, British Museum specimen P. 6796.
Nat. size.

cl., cleithrum; *csc.*, the possible coraco-scapula; *1.axt.*, the first axonost or the basal; *2.axt.*, second axonost; *3.axt.*, third axonost; *4.axt.*, fourth axonost; *I.pra.r.*, first preaxial radial; *II.pra.r.*, second preaxial radial; *III.pra.r.*, third preaxial radial; *pa.pr.*, postaxial process; dermal rays are represented by lines.

Finally, the fourth piece of the axis is somewhat constricted in the middle, and quite distinctly bifurcated posteriorly (a feature not marked in the figure of A. S. Woodward, 1898). When looked at with a magnifying-glass, these two posterior branches seem to continue in two separate ossifications, so that the composition of this fourth axonost of two separate parts is not improbable, although not to be affirmed with certainty, the separating line between the two being perhaps due to a crack. One sees also with the magnifying-glass the clear attachment of a dermal ray to the left of these two bifurcations, while a fragment of somewhat crushed bony matter attached to the right bifurcation also probably represents dermal rays.

There are three preaxial radials in our specimen. The uppermost radial is attached to one of the two articulating surfaces of the basal axonost; it is bent inwards in the middle and constricted posteriorly. The new preparation shows the attachment of the dermal rays to this radial very clearly. The second radial, attached to the smaller of the two articulating surfaces of the second axonost, is also constricted posteriorly, but not sufficiently preserved in its posterior part. The third radial, better preserved than the second, is constricted in the middle, but the limit of its posterior part is indeterminable. It is attached to the smaller of the two articulating bifurcations of the third axonost.

There are only two postaxial processes in our specimen, and no postaxial radials at all. The first process is a large prolongation of the basal axonost (this prolongation is not well visible in the figure of A. S. Woodward, 1898), and the second a prolongation of the third axonost, while the second and the fourth axonosts are devoid of similar processes (on the left side of the second axonost some bony matter is visible in our specimen, but it is evidently a crushed scale).

Having finished the description of the fin in question, I will add some remarks concerning the problem of the origin of the tetrapod limb. The resemblance of the internal skeleton of the pectoral (and also of the pelvic) fin in *Eusthenopteron* to the internal skeleton in the tetrapod limb has been emphasized by several authors (by Patten, Watson, Broom, Gregory), and Watson especially has tried to point out in detail the homologies of both (comp. Watson, 1913, p. 25 *seq.* and figs. 1 & 2). But his restoration of the pectoral fin of *Eusthenopteron* (*l. c.* fig. 2) is wrong, inasmuch as he takes no account of the posterior bifurcation of the fourth axonost (in this respect the restoration of Broom, 1913, p. 460, fig. 1, is more accurate) and represents the postaxial process of the

basal axonost as a separate postaxial radial (in this respect the restoration of Broom is exact).

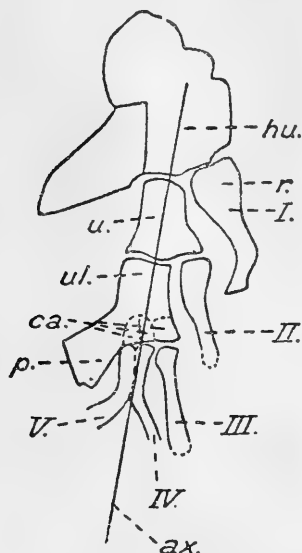
Now I consider the posterior bifurcation of the fourth axonost in our specimen as of exceptional importance for the question of homologies. As the pelvic fin of *Eusthenopteron* is far more reduced than its pectoral fin (comp. fig. 1 of pl. xvi. in Goodrich, 1902, which shows that there is no fourth axonost in the pelvic fin—British Museum specimen P. 6794—and no postaxial processes), we must infer that the paired fins of *Eusthenopteron* represent a stage far in advance of that stage of the paired fins in its ancestors, which was the starting-point for the evolution of the paired limbs in the primitive ancestors of the Tetrapoda*. If this inference is a right one, then it is not improbable that the posterior bifurcation of the fourth axonost in our specimen is a remnant of a more primitive stage when the fourth axonost was composed of two separate ossifications, the paired fins of *Eusthenopteron* being evidently the reduced archipterygium-type of Gegenbaur (a resemblance recognized by Woodward, Traquair, and others). So that we have to conclude from this evolution that the axis of the tetrapod limb runs along the humerus, ulna, ulnare, and between the fourth and fifth finger † (comp. text-fig. 2, in which some further hypothetical homologies have been indicated). This conclusion, as one sees,

* This conclusion is confirmed also by the skull, which in *Eusthenopteron* is simpler than in the more primitive Osteolepidae, whose paired fins are also less reduced (comp. the fins of *Megalichthys* figured by Ed. D. Wellburn in his paper "On the Genus *Megalichthys*," in Proc. Yorkshire Geol. & Polytechnic Soc. vol. xiv., 1900). I may add in this connexion that the skull of *Osteolepis* may be considered to approach nearer to the Stegocephalian skull than is shown by the restoration of Pander (comp. Chr. H. Pander, 'Ueber die Saurodipterynen, &c.,' 1860, pl. i. figs. 8 & 9), lately reproduced by Gregory (comp. Gregory, 1915, fig. 2, A, B). Pander's restoration was founded on the specimen of *Osteolepis microlepidotus* figured by him in pl. i. fig. 1; but fig. 4 on the same plate represents a specimen in which all the three characteristic bones of the Stegocephalian skull (supratemporal, intertemporal, post-orbital) are present.

† The pectoral fin of *Sauripterus taylori* (figured and restored by Gregory, 1915, plate iv. and fig. 9) does not militate against this supposition. This fin, less reduced than that of *Eusthenopteron*, has three elements attached to the third axonost, so that these three elements may correspond with the three digits on the ulnar side of the tetrapod limb. As the two outer of these three elements have almost the same length, it may well be supposed that the axis runs between the two (and not along the outer one alone, as Gregory hypothetically supposes—comp. Gregory, 1915, p. 360). I should mention that the first to emphasize the resemblance of the *Sauripterus*-fin with the tetrapod limb was its discoverer, James Hall himself (comp. J. Hall, 'Geology of New York,' part iv. 1843, p. 282).

does not entirely confirm the theory of Gegenbaur, according to which the tetrapod limb is derived from a reduced uniserial archipterygium (comp. Gegenbaur, 1898, p. 520), but nevertheless it is more in conformity with this theory than with the other (also advocated by Watson), which takes a reduced biserial archipterygium for the base of the tetrapod limb.

Fig. 2.



The internal skeleton of the Pectoral Fin of *Eusthenopteron*, showing homologies with the tetrapod limb. Nat. size.

hu., humerus; u., ulna; r., radius; ul., ulnare; p., pisiform; ca., three distal carpalia; I.-V., digits; ax., axis of the tetrapod limb.

In conclusion, I desire to express my thanks to Dr. Smith Woodward for the loan of the new preparation and for valuable help.

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XLIX.—*Descriptions and Records of Bees.*—LXXXII.

By T. D. A. COCKERELL, University of Colorado.

Exomalopsis mellipes, Cresson.

The male, not before known, has been collected by H. H. Hyde at Medellin, Vera Cruz, Mexico (Baker coll., 1785). It runs in Friese's table of males to *E. planiceps*, Sm., but is larger, with red legs.

Exomalopsis vincentana, Cockerell.

The male, previously unknown, was collected by H. H. Smith on the windward side of St. Vincent. It is hardly 5 mm. long, and there is much black hair on mesothorax, scutellum, and legs. It is nearest to *E. globosa*, but distinguished at once by the ochreous-yellow tarsi.

There is a series of small *Exomalopsis* (including *Anthophorula*), which are superficially similar and easily confused. They may be separated by the following table, based on females :—

Second abdominal segment with oblique stripes of light hair at sides, but no apical band	1.
--	----

- | | | |
|---|----|-------------------------------|
| Second abdominal segment with an apical hair-band | 3. | |
| 1. Disc of scutellum with black hair | | <i>globosa</i> (Fabr.). |
| Disc of scutellum with fulvous hair | 2. | |
| 2. Basitarsus with much black hair | | <i>pulchella</i> , Cresson. |
| Basitarsus with pale hair | | <i>similis</i> , Cresson. |
| 3. Second segment of abdomen with a narrow apical band of snow-white hair | | <i>verbesinae</i> , Ckll. |
| Second segment with a broad band | 4. | |
| 4. Abdominal hair-bands clear white; eyes green | | <i>chlorina</i> , sp. n. |
| Abdominal bands greyish or yellowish; eyes not green | 5. | |
| 5. Hind legs with much black hair | 6. | |
| Hind legs with hair mainly or nearly all pale; species of <i>Anthophorula</i> | 7. | |
| 6. Flagellum ferruginous beneath, abdomen broader | | <i>nitens</i> , Ckll. |
| Flagellum dark coffee-brown beneath | | <i>albovittata</i> , sp. n. |
| 7. Tegulae rufo-testaceous; stigma larger, pale amber | | <i>texana</i> , Friese. |
| Tegulae dark; stigma smaller | 8. | |
| 8. Disc of mesothorax polished and smooth | | <i>coquilletti</i> , Ashmead. |
| Disc of mesothorax punctured | | <i>morgani</i> , Ckll. |

Exomalopsis albovittata, sp. n.

♀.—Length nearly 7 mm.

Closely allied to the Californian *E. nitens*, but less robust; flagellum dark; hair of face pure white; disc of mesothorax with fine but distinct punctures; hair of scutellum shorter and greyish instead of yellowish; hair on base of first abdominal segment pure white, apex of first segment with only a rather small patch of white hair on each side. The loose scopa of hind tibiae and tarsi is black behind (above) and white in front; the wings are dusky, and the tegulae are piceous.

Oaxaca, Mexico (*Crawford*). U.S. Nat. Museum.

There is some resemblance to *Leptergatis globulifera*, but the front is smooth and shining in the *Exomalopsis*, densely punctured in the *Leptergatis*.

Exomalopsis chlorina, sp. n.

♀.—Length about 6 mm.

Eyes bluish green; hair at sides of face dense and pure white; flagellum red beneath, dark above; hair of thorax white; tegulae rufo-piceous; wings clear, stigma and nervures pale amber; stigma much smaller than in *E. texana*; bands on abdominal segments 2-5 broad and pure white; scopa of hind legs on outer side white, blackish at base of tibia,

dark fuscous on inner side of basitarsi; mesothorax very distinctly punctured; tarsi red at apex.

Las Cruces, New Mexico, at flowers of *Sphæralcea* in garden of my house, Aug. 24 (*Cockerell*).

I had confused this with *E. texana*, but, having received a topotype of the latter, I find it is quite distinct.

Exomalopsis thermalis, sp. n.

♀.—Length about 9 mm.

Very robust, black; hair of head and thorax long and white, with a slight creamy tint; head very broad; eyes olive-green; labrum black; mandibles chestnut-red in middle; clypeus flattened, shining, sparsely punctured; flagellum chestnut-red beneath; mesothorax closely and strongly punctured; scutellum shining, with very fine punctures; tegulae bright rufo-fulvous. Wings yellowish, the large stigma and the nervures clear ferruginous; small joints of tarsi red; hair on inner side of tarsi ferruginous; middle tibiae with short fuscous hair on outer side beyond middle; middle basitarsi with long white hair on outer side; scopa of hind legs long and plumose, largely black on outer side, that on basitarsus of three colours—black, white, and red. Abdomen very broad, with a glaucous tint; first two segments closely punctured as far as the narrow arched pale hair-band, beyond that smooth and shining, the second segment with excessively minute punctures; segments 3 to 5 with broad bands of yellowish tomentum, the fifth broadly fringed with fuscous hair apically.

Agua Calientes, Mexico, Dec. 1, 1909 (*F. C. Bishopp*).
U.S. Nat. Museum.

Exomalopsis crucis, sp. n.

♀.—Length about 8.5 mm.

Closely allied to the last, differing thus: scape more or less reddish, especially at base; flagellum pale ferruginous beneath; labrum clear red, with pale reddish hair; hair of thorax above strongly tinged with yellowish; scutellum closely and very distinctly punctured; first abdominal segment reddish basally.

Medellin, Vera Cruz, Mexico (*H. H. Hyde*; Baker coll., 1785). U.S. Nat. Museum.

These two species are related to *E. mellipes*, Cress. (which has red legs); and more especially to *E. frederici*, Ckll., which has the tarsi, and tibiae at apex, ferruginous—at

least, in the male (female unknown). I questioned whether *E. thermalis* might be the female of *frederici*, but the fine short pile on basal part of third abdominal segment in *thermalis* is pale greyish ochreous, in *frederici* it is black. The hind spurs of *thermalis* and *crucis* are strongly curved at end, as in *frederici*. A second specimen of *E. crucis* comes from San Juan Allende, Mexico, Nov. 29 (C. H. T. Townsend).

Leptergatis globulifera, Cockerell.

The female, not before known, was taken by M. A. Carriker at Aroa, Venezuela, Dec. 12, 1910. It is much like *L. armata*, Sm., but has redder antennæ. From the female alone, I should have regarded the insect as a local race of *armata*.

Tetrapedia diversipes, Klug.

Manaos, Brazil (Miss H. B. Merrill); San Bernardino, Paraguay (K. Fiebrig).

Nomada calloptera, sp. n.

♂.—Length about 10·5 mm.; expanse about 18·5.

Head and thorax black, densely punctured, with long and abundant pale fulvous hair; lower corners of face broadly (with a sharply pointed extension upward along orbit), broad band along lower margin of clypeus, base of the simple mandibles, labrum (which is not dentate) and the rather stout scape in front, all yellow; eyes pale grey; flagellum thick, simple, black above (except the sutures), ferruginous beneath; third antennal joint brighter red, about half as long as fourth; scutellum bigibbous, very coarsely punctured; tubercles red and polished, but no other light marks on thorax; tegulæ red. Wings clear, the apex fuscous; stigma clear bright ferruginous, nervures fuscous; b. n. going a short distance basad of t.-m.; first and second t.-c. nervures convex outwardly. Legs red, anterior tibiæ with an apical yellow spot; middle trochanters black above, with a red spot, and highly polished; middle femora black beneath basally; hind femora black behind except at apex. Abdomen red with rather pale yellow markings, hind margins of first three segments broadly fuscous, first segment with more than basal half black, and small yellow marks sublaterally; second segment black at base, and with a very large yellow patch (not pointed mesad) on each side; third

with a very broadly interrupted yellow band, excavated behind sublaterally; fourth to sixth with yellow bands, interrupted by a red spot on each side; apical plate broad, notched; venter red with yellow bands.

Tokyo, Japan, April 12, 1909 (*Sasaki*). U.S. Nat. Museum. It is also labelled Yamada.

In the table of Palaearctic species it runs near *N. manni*, Moraw., differing by the black scutellum. It is quite distinct from all those described from Japan. It is a large species of *Nomada*, s. str.

Nomada pyrifera, sp. n.

♀.—Length about 10 mm.

Head and thorax red with black markings, closely punctured, the hair white; labrum pale yellow, with no distinct tooth; malar space pale yellowish; mandibles simple, red, black at apex; lower part of clypeus, and lower part of supraclypeal area, suffusedly yellowish; middle of front, extending to occiput, black, and cheeks black with a broad red band behind eyes; antennæ entirely red, long, reaching to base of abdomen; third joint scarcely half as long as fourth (this at once separates it from the superficially similar *N. japonica*, Sm.); mesothorax with three black bands, confluent in front; scutellum strongly elevated, entirely red; area of metathorax black in middle and red sublaterally; pleura nearly all red; no yellow on thorax; tegulæ pale red. Wings clear, dilute fuscous at apex; stigma ferruginous; nervures fuscous; b. n. going far basad of t.-m.; second s.m. very broad, receiving first r. n. about middle. Legs bright ferruginous, hind femora with a black stripe behind. Abdomen smooth and polished, ferruginous; basal half of first segment black, second segment with a very large pyriform (pointed mesad) spot on each side; fourth and fifth segments with yellow bands, failing laterally; venter with broad yellow bands.

Japan (presumably Tokyo), May (*Sasaki*). U.S. Nat. Museum.

This also runs near *N. manni* in the Palaearctic fauna, but is readily distinguished by the pattern of abdomen and the red scutellum. *Sasaki* collected two males, of different species, which looked like *N. pyrifera*. One I have described as *N. calloptera*, as it differs from *pyrifera* in the colour of the stigma and the basal nervure going less basad; the other, collected at Tokyo in April, I suppose to be the true male of *pyrifera*. It is unfortunately in very bad condition, but

the following characters can be made out : mandibles largely yellow ; face densely covered with white hair ; scape swollen, yellow in front ; mesothorax all black ; tubercles yellow ; scutellum with yellowish or reddish spots ; metathorax and pleura all black ; venation and colour of stigma as in *pyrifer* ; first abdominal segment with basal half black, apical half red, and two large yellow spots, not far apart, on the red ; second segment with pyriform marks larger, meeting in the middle line ; segments 3 to 6 with entire yellow bands ; apical plate feebly notched ; venter with yellow bands.

Andrena melanospila, sp. n.

♀.—Length 10 mm.

Black, the head and thorax with copious moderately long hair, dull white on face, cheeks, and pleura, pale fulvous on occiput and dorsum of thorax (brightest on scutellum), but black on mesothorax posteriorly, and on front and vertex ; malar space linear ; process of labrum rather narrow, obtuse ; clypeus brightly polished, with sparse small punctures ; facial foveæ broad, dark brown, not extending below level of antennæ ; antennæ dark ; third joint much longer than fourth, but not quite as long as fourth and fifth ; mesothorax dull and granular, shining posteriorly ; scutellum shining, without evident punctures ; area of metathorax dull and finely granular ; tegulæ piceous. Wings dusky, the large stigma and nervures dull reddish ; b. n. meeting t.-m. ; second s.m. receiving first r. n. distinctly beyond middle ; scopa of hind tibiæ white in front and black behind. Abdomen dull, not punctured ; second segment depressed scarcely a fourth ; hind margins of segments 2 to 4 with narrow pure white hair-bands ; caudal fimbria purplish black.

Soochow, China (*N. Gist Gee*). U.S. Nat. Museum.

In the Palæarctic fauna this falls near to *A. denticulata* (Kirby), from which it is easily separated by the narrow white abdominal bands and the black and white hair of hind tibiæ. It is not like any of the species described by Strand from Tsingtau. The abdominal bands are as in *A. wilkella*, but that has an entirely different clypeus.

Andrena delicatula, sp. n.

♂.—Length 8 mm.

Black, superficially exactly like *A. albicrus*, but running in tables of Palæarctic species to *A. lapponica*, which is a

larger insect. Hair of head and thorax long and white, very faintly yellowish on scutellum, a little blackish hair at sides of face; mandibles long and curved; process of labrum weakly bilobed; clypeus dull, covered with long white hair; antennæ entirely dark; third joint about equal to fourth; mesothorax and area of metathorax dull and granular; tegulæ piceous, reddish posteriorly. Wings slightly dusky; the large stigma and nervures dull ferruginous; b. n. falling some distance short of t.-m.; second s.m. broad, receiving first r. n. at middle. Legs black; tarsi reddish at apex. Abdomen shining, not punctured, segments 2 to 4 with thin white hair-bands at sides only; apex emarginate.

Soochow, China (*N. Gist Gee*, 121). U.S. Nat. Museum.

The abdomen has little of the long loose hair so conspicuous in *A. albicrus*. Among the Japanese species, this falls nearest to *A. præcociformis*, Ckll., which is larger, with shining clypeus and chestnut-red stigma. The cheeks are broader and flatter in *A. delicatula*. From Soochow also comes *Nomia chalybeata*, Smith (*N. Gist Gee*, 140).

• *Agapostemon cockerelli*, Crawford.

Longmont, Colorado, Sept. 7, 1918 (*Cockerell*). New to Colorado.

Colletes sieverti, Cockerell.

Gregory Canyon, Boulder, Colorado, July 13 (*Cockerell*).

Trigona ruficrus corvina, Cockerell.

Chagres River, Panama Canal Zone, Oct. 9, 1917, "chewing on the leaves of young citrus plants" (*Harold Morrison*).

L.—*A new Species of Eligmodontia from Catamarca.*
By OLDFIELD THOMAS.

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THE British Museum has recently received a small collection of mammals from Chumbicha, Catamarca, collected by Sr. E. Budin, and among them there occur specimens of the following new species:—

Eligmodontia marica, sp. n.

Size smaller than in other species. Fur soft and fine, hairs of back about 7 mm. in length. General colour above pale sandy buff, darker along the back, paler on the sides where it is nearly "pinkish buff." Whole of under surface pure sharply defined white, all the hairs, even laterally, white to their bases. Middle of face and crown darker buffy like the back, area between eyes and ears, and a patch above each eye paler like the sides. Ears large, the usual piebald arrangement of their colour strongly marked; a whitish patch at base of proectote, middle part of proectote nearly black, terminal part and whole of metentote greyish buffy, the fine hairs along the edge white. Limbs wholly white, the buffy body-colour not or scarcely encroaching on the white of the upper arms; palms and soles with the structure characteristic of *Eligmodontia*, but the hairy covering quite thinly spread. Tail longer than head and body, dull buffy above, whitish below, the contrast not so marked as it is in the southern species.

Skull markedly smaller than that of the other species, especially as compared with that of the forms geographically nearest.

Dimensions of the type (measured in the flesh):—

Head and body 65 mm.; tail 93; hind foot 20; ear 15.

Skull: greatest length 21.4; zygomatic breadth 12; nasals 8; interorbital breadth 3.8; breadth of brain-case 11; palatilar length 9.3; palatal foramina 4.8; upper molar series 3.5.

Hab. Chumbicha, Catamarca. Alt. 600 m.

Type. Young adult male. B.M. no. 18.11.11.1. Original number 311. Collected 30th July, 1918. Presented by Oldfield Thomas.

This beautiful little mouse is the smallest species of the genus and is readily distinguishable by size from *E. hirtipes* and *moreni*, occurring north and south of it respectively. *E. typus*, with which the *Bahia Blanca elegans* is always assumed to be synonymous, is also larger, and the belly-hairs are broadly slaty at base. The more southern *E. morgani* has a proportionally shorter tail.

Sr, Budin says of *E. marica*:—"This pretty mouse has been the one which has most pleased and interested me of all the rodents. It was caught among the prickly pears ['pencas'] in one place only, in a space some 40 square

metres in area, where I obtained four specimens, but saw none anywhere else, and it is evidently very rare."

[As an indication of the extent to which our British National Museum has participated in the general advance in the systematic knowledge of Mammalia, and the corresponding accumulation of typical specimens, I may perhaps be permitted to record that, so far as I am able to calculate, this is the two-thousandth mammal to which, as the official mammalogist of the Museum, I have had occasion to give a name. And many hundreds more have been described and named by other workers. The vastness of the collection—especially of types—indicated by these figures is due mainly to the patriotism of our countrymen all over the world, many of whom have been proud and pleased to contribute to their National Museum merely because it is the National Museum, without pay or return, and often in climates where mere existence is a burden.

Having possessed for forty years the great privilege of working on this wonderful collection, I feel I cannot too strongly express my appreciation of the generosity and public spirit shown by its many contributors—whether those who at home have provided funds for making expeditions, or abroad have made collections to be added to the National treasures.

My own share in the work, carried on as it has been under the most favourable conditions, has been a continuous pleasure. And in appreciation of one important element in this pleasure, the sympathetic and ever-ready help of my wife, I have given to this attractive little animal the above specific name.]

LI.—*Two new Forms of Leggada.*

By OLDFIELD THOMAS.

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Leggada bella sybilla, subsp. n.

Near *L. b. induta*, but with much shorter fur.

Hairs of back about 4.0–4.5 mm. in length. General colour buffy, not so bright as in *induta*, and broadly darkened on the back, the flanks clear buffy. Belly pure sharply defined white. A very small subaural white spot. Hands and feet white. Tail pale greyish above, white below.

Skull about as in *induta*, smaller than in *minutoides*, slightly larger than in *marica*. Posterior nares of normal shape.

Dimensions of the type:—

Head and body 55 mm.; tail 46; hind foot 13.

Skull: greatest length 18; condylo-incisive length 16·3; nasals 6·8; breadth of brain-case 8·5; palatal foramina 4; upper molar series 3·0.

Hab. Benguella, Angola. Type from the Usolo River.

Type. Adult female. B.M. no. 5. 5. 9. 70. Original number 7. Collected 18th July, 1904, by Dr. W. J. Ansorge. Seven specimens.

The type of *sybilla* was captured at the same time of year as that of *induta*, so that the difference in the fur is not seasonal. Dr. Ansorge also obtained examples of this pretty mouse in November and December. In *L. b. marica* the molars are only 2·6 mm. in length.

Leggada paulina, sp. n.

Intermediate between the two West-African species *L. musculoides* and *setulosa*.

Size markedly less than in *setulosa*, rather greater than in *musculoides*. General colour greyish mouse-colour above, with a wash of drabby or buffy along the cheeks, shoulders, and flanks. Under surface pure white, not so sharply defined as in *musculoides*. Ears small, as in *musculoides*. Forearms tinged with buffy, legs greyish; hands and feet white. Tail so thinly haired as to appear naked to the unaided eye, the fine hairs brown above, whitish below; the scales brown throughout.

Skull intermediate between those of *setulosa* and *musculoides*. Brain-case rounded, not so flattened as in *musculoides*. Masseteric knob of zygomatic plate near its anterior border.

Dimensions of the type (measured in flesh):—

Head and body 67 mm.; tail 48; hind foot 13·7; ear 9·5.

Skull: greatest length 18·2; condylo-incisive length 16·5; zygomatic breadth 9; nasals 6·7; interorbital breadth 3·6; breadth of brain-case 8·4; palatilar length 7·9; palatal foramina 3·9; upper molar series 3.

Hab. Bitye, Ja River, S.E. Cameroons. 2000'.

Type. Adult female. B.M. no. 14. 1. 24. 27. Original number 694. Collected 15th September, 1913, by Mr. G. L. Bates.

Though evidently allied to *L. musculoides*, of which it may

be a Cameroons representative, this mouse is distinguishable by its larger skull and darker coloration, in which latter it nearly resembles the common Cameroons *L. setulosa*, in whose company it was captured, and for whose young it might readily be mistaken.

LII.—*Contributions to a further Knowledge of the Rhynchotal Family Lygaeidae.* By W. L. DISTANT.

[Continued from p. 270.]

Astacops tigrinus, sp. n.

Head, pronotum, scutellum, and corium pale ochraceous; antennæ black, basal joint ochraceous; apices of the stylated eyes black; body beneath pale ochraceous with prominent transverse, somewhat broad, black fasciæ, the most prominent being at the anterior margins of the meso- and metasterna, and at the posterior margins of the abdominal segments, there is also a small black spot on each side of the anterior marginal area of the prosternum and a central black longitudinal fascia on the apical abdominal segment; legs black, anterior and intermediate femora (excluding bases), apical third of posterior femora, and extreme bases of tibiæ ochraceous; tarsi mostly black; antennæ with the second and fourth joints subequal in length, each a little longer than third; scutellum transversely subconvex on basal area, centrally thence to apex strongly carinate; membrane black, apical margin pale and passing the abdominal apex.

Long. 12 mm.

Hab. Philippine Islands; Mindoro Island, Baco River (*J. J. Mounsey*).

Scopiates nigripes.

Scopiates nigripes, Dist. Ann. & Mag. Nat. Hist. (7) vii. p. 533 (1901).

Astacops melampus, Bergr. Phil. Journ. Sci. xiii. p. 57 (1918).

Hab. Queensland.

Macropes simoni, sp. n.

Head, pronotum, scutellum, body beneath, and legs black; antennæ piccous, apical joint black; hemelytra pale creamy yellow, clavus brown, vein outside clavus also brown, nearly

apical half of corium black; membrane with the base black, and with a large discal spot fuscous with the veins black; antennæ with the first and second joints subequal in length, each a little shorter than fourth; rostrum passing the anterior coxæ; pronotum with the anterior lobes smooth, shining, black, punctate anteriorly and laterally, with two finely impressed central longitudinal lines, posterior lobe more opaque and thickly punctate, anterior lobe not prominently broadened as in *M. philippinensis*, Dist., but gradually somewhat convexly narrowed to apex; membrane reaching or very slightly passing the anterior margin of the apical abdominal segment; scutellum centrally, longitudinally carinate.

Var. Abdomen beneath and the legs brownish ochraceous. Long. $5-5\frac{1}{2}$ mm.

Hab. Philippine Islands (*E. Simon*).

A species readily distinguished from *M. philippinensis*, Dist., by its small size and structure of the pronotum, &c. Bergroth has recently described another small species, *M. lacertosus*, from the same habitat, but, as he states "pronotum in the male with the greatest width before the middle" and with different colour-markings to the "elytra," it cannot be confused with his specific creation.

Dinomachus marshalli, Dist. Ann. & Mag. Nat. Hist. (7) viii. p. 473 (1901).

Bergroth, my constant but by no means infallible critic, has recently (Medd. Mus. Zool. Afd., Gottenborg, p. 6, 1914) referred to my very short and quite misleading "description of the genus." He states that I have "omitted the most important character of *D. marshalli*, viz., the extraordinary length of the rostrum, which reaches the middle of the abdomen." As I had only an imperfect specimen before me when I wrote my description (I described the imperfect condition of the antennæ), I could not describe a mutilated rostrum. However, few regard Bergroth's animadversions too seriously.

Add. Hab. Mashonaland; Salisbury (*Marshall*). Mozambique; Bazi River, Zululand (*Bell-Marley and Warren*). Transvaal; Lydenburg (*Krantz*); Natal; Durban (*Bell-Marley*)—Brit. Mus.

In the above series the length varies from 8 to $11\frac{1}{2}$ mm.

I have already described species of *Dinomachus* from the Oriental Region, and I now add another two species from Australia.

Dinomachus kurandæ, sp. n.

Head black with a basal spot between the ocelli and the apex of the central lobe ochraceous; pronotum ochraceous, somewhat thickly, coarsely, darkly punctate; narrow lateral and anterior margins, a slender central longitudinal carination, and two similar but oblique carinations on posterior lobe dull ochraceous; scutellum very coarsely darkly punctate, a central longitudinal carination on posterior half, which apically bifurcates on each side, ochraceous; corium ochraceous, thickly, coarsely, darkly punctate, the lateral margins very narrowly ochraceous, apical angles ochraceous with a small black spot; membrane bronzy brown; body beneath imperfectly seen in carded type; legs very pale ochraceous, subapical areas of the femora and annulations to the tibiæ and tarsi castaneous; antennæ pale ochraceous, apex of the second joint and nearly the whole of the third and fourth joints pale brownish, second joint much the longest, third and fourth joints almost subequal in length, first joint distinctly passing apex of head; rostrum imperfectly seen in carded type.

Long. 7 mm.

Hab. Queensland; Kuranda (*F. P. Dodd*).

Dinomachus doddi, sp. n.

Head castaneous, coarsely punctate, apex of central lobe and a central longitudinal line between ocelli ochraceous; pronotum ochraceous, somewhat darkly punctate, a broad, subanterior, transverse fascia, two central longitudinal spots at base, and a submarginal line on posterior lobe castaneous; scutellum castaneous, coarsely punctate, a central longitudinal carinate line obliquely branching on each side of apex castaneous; corium ochraceous, coarsely punctate, its extreme apical margin piceous; membrane pale bronzy; body beneath castaneous; rostrum, coxæ, legs, disk, apex and segmental marginal spots to abdomen beneath ochraceous; rostrum about reaching the intermediate coxæ; sternum very coarsely punctate; antennæ ochraceous, apices of the first, second, and third joints and nearly the whole of fourth joint pale castaneous, second joint longest, third a little longer than fourth; pronotum with a central longitudinal carinate line and with the subanterior transverse fascia slightly globose and very sparingly punctate.

Long. 8 mm.

Hab. Queensland; Kuranda (*F. P. Dodd*).

Masoas transvaaliensis, Dist. Ann. & Mag. Nat. Hist. (7) xviii. p. 290 (1906).

The type of this species was from the Transvaal (Pretoria); the Brit. Mus. now contains two other specimens from Angola which are slightly larger, measuring in length $4\frac{1}{2}$ mm. The type has only a dimension of $3\frac{1}{2}$ mm.

Oxycarenus collaris, Muls. & Rey. Ann. Soc. Lin. Lyon, 1852, p. 102; Oshan, Verz. Pal. Hem. Bd. 1, Heteropt. p. 300 (1906).

This Palearctic species, as hitherto understood, must now be also included in the Oriental fauna, as the British Museum has recently received specimens from the Agricultural College, Poona. It was found "infesting in large numbers the capsules of the safflower plant grown in Poona" (*Harold Mann*).

Maruthas bicolor.

Maruthas bicolor, Dist. Nov. Caledon. 1, L. iv. p. 379, pl. xi. fig. 5 (1914).

Oxycarenus bicoloratus, Bergr. Phil. Journ. Sci. xiii. p. 73 (1918).

Hab. New Caledonia.

Clerada apicicornis, Sign. in Maillard, Notes sur l'Ile de la Réunion, Ins. p. 28, pl. xx. fig. 8 (1862).

This very widely distributed species can now be recorded from Queensland; Kuranda (*F. P. Dodd*).

Pamera tricolorata, sp. n.

Head, pronotum, and scutellum black; corium dark castaneous; apex of scutellum and lateral marginal area of corium to beyond middle ochraceous, on apical area of corium two pale ochraceous or greyish spots in transverse series, in some specimens these spots are united and in others they are practically absent; membrane brownish ochraceous; body beneath and legs black; apices of femora, basal areas of intermediate and posterior femora, and the whole of the tibiae and tarsi ochraceous; antennae piceous, second joint paler, fourth joint with basal half pale ochraceous, second joint a little longest, third and fourth almost subequal in length; anterior lobe of pronotum with a distinct anterior collar, convex, a little longer than posterior lobe but narrower, the posterior lobe somewhat coarsely punctate; scutellum centrally longitudinally carinate, the carination

bifurcate towards base; corium, excluding lateral marginal area, more or less thickly punctate; membrane not passing abdominal apex; rostrum reaching or slightly passing anterior coxæ.

Long. 6-7 mm.

Hab. Queensland; Kuranda (June-July, R. E. Turner; April, F. P. Dodd). Adelaide River (J. J. Walker). Tenimber Island (W. Doherty).

Pamera vincta, Say.

This very widely distributed species has now been received from Queensland (Townsville), where it was taken by Mr. F. P. Dodd.

AUSTROPAMERA, gen. nov.

Head long, anteocular portion about as long as postocular, but the anteocular portion acuminate apically produced; eyes moderately prominent; ocelli situate a little behind a line between the posterior margins of the eyes; antennæ inserted a little in front of eyes, first joint about as long as head, second longest; pronotum with a narrow anterior collar about as long as broad at base, strongly laterally sinuate, the anterior lobe subglobose and shorter than the posterior lobe; rostrum slightly passing the anterior coxæ, first joint not reaching base of head; scutellum about as broad at base as long, obliquely transversely ridged; corium elongate; membrane reaching abdominal apex; anterior femora strongly incrassated; body beneath with the apical lateral angle of the posterior abdominal segment moderately acute.

Allied to the Oriental genus *Pamerana*, Dist., from which it differs by the non-spinuous antenniferous tubercles, the much longer postocular area of the head, &c.

Austropamera turneri, sp. n.

Head and pronotum black, posterior pronotal area strongly punctate; ocelli red; antennæ dull ochraceous, apices of the first and second joints, the whole of third, and about basal half of fourth joint black, basal joint about as long as head, second longest; scutellum black, centrally, obliquely transversely testaceously ridged; corium dull ochraceous, clavus and outer claval area darkly punctate, a broad, transverse, black fascia beyond middle and the apical areas black; membrane dull black; head beneath and sternum black;

abdomen dull dark castaneous, with an ochraceous lateral marginal spot a little beyond middle; rostrum and anterior legs castaneous, extreme femoral apices and bases of tarsi ochraceous; anterior and posterior legs ochraceous, apices of femora castaneous; other structural characters as in generic diagnosis.

Long. $7\frac{1}{2}$ mm.

Hab. Queensland; Kuranda, 1-100 feet (*R. E. Turner*, May and June).

ARRIANOIDES, gen. nov.

Head elongate, about as long as breadth between eyes, narrowed towards apex; eyes not projecting beyond the pronotal angles; first joint of antennæ distinctly passing apex of head; pronotum about as long as broad, transversely impressed at middle, the lateral margins very slightly ampliatedly produced, moderately narrowed from bases to anterior margin, anterior lobe moderately convex; scutellum about as long as broad at base, its apex linearly acute, the disk broadly foveate; corium about twice as long as broad; membrane reaching the abdominal apex; anterior femora moderately incrassated and spined beneath on apical area; rostrum imperfectly seen in carded specimen.

Allied to *Arrianus*, Dist., and *Teutates* Dist.

Arrianoides australis, sp. n.

Head, anterior lobe of pronotum, scutellum, and disk of corium black; posterior pronotal lobe, claval area, and extreme lateral margins to corium more or less castaneous; a large white spot on apical area of pronotum, the extreme apex of which is castaneous; extreme lateral margins and basal angles of pronotum and apical spot to clavus pale castaneous or ochraceous; body beneath (imperfectly seen in carded specimen) with the sternum black and the abdomen dark testaceous; antennæ ochraceous, first joint passing apex of head, second longest, third longer than fourth; anterior lobe of pronotum convex and almost impunctate, posterior lobe distinctly punctate, a somewhat obscure central longitudinal impression neither reaching anterior nor posterior margins; claval area distinctly punctate; femora pale castaneous; tibiæ and tarsi ochraceous; membrane bronzy-brown. Other structural characters as in generic diagnosis.

Long. 5 mm.

Hab. Queensland; Townsville (*F. P. Dodd*).

Poeantius lineatus.*Poeantius lineatus*, Stål, En. Hem. iv. p. 162 (1874).*Poeantius brevicollis*, Bredd. Deutsch. ent. Zeitschr. 1907, p. 207.

This widely distributed species may now also be recorded from Australia. Queensland; Townsville (*F. P. Dodd*).

Naudarensia rolandi, sp. n.

Head, anterior lobe of pronotum, and scutellum glossy black; posterior pronotal lobe and corium more piceous; basal angles of pronotum, narrow lateral margins, and two spots on apical areas of corium dull greyish ochraceous; body beneath shining black; femora shining black, their apices and the tibiæ and tarsi ochraceous, apices of tibiæ and tarsi black; antennæ dull ochraceous, second and fourth joints longest, and almost subequal in length, the apical joint piceous, first joint not reaching apex of head; pronotum about as long as broad at base, transversely constricted behind middle; head and anterior lobe of pronotum glabrous, posterior pronotal lobe thickly coarsely punctate; membrane reaching apex of penultimate abdominal segment; corium sparingly coarsely punctate; rostrum not quite reaching the intermediate coxæ; tibiæ finely spinulose; anterior tibiæ moderately dilated at apices.

Long. $5\frac{1}{2}$ mm.

Hab. S.W. Australia; Yallingup (*R. E. Turner*).

This genus was hitherto only known from Continental India.

Daerlac nigricans, sp. n.

Black; apical angular area to corium and posterior half of connexivum ochraceous; body beneath imperfectly seen in carded specimen; membrane fuscous brown; antennæ with the first joint passing apex of head, second, third, and fourth joints almost subequal in length; head above thickly, finely punctate, obliquely directed from near eyes to apex; pronotum longer than broad, anterior lobe globose, and thickly punctate, about twice as long as posterior lobe, from which it is deeply transversely separated; posterior margin slightly concave; scutellum about as long as broad at base, its extreme apex ochraceous; clavus coarsely punctate; corium more finely punctate; anterior femora strongly globose, posterior femora moderately incrassate, intermediate femora less prominently incrassate.

Long. $8\frac{1}{2}$ –9 mm.

Hab. N.S. Wales, Sydney (*J. J. Walker*).

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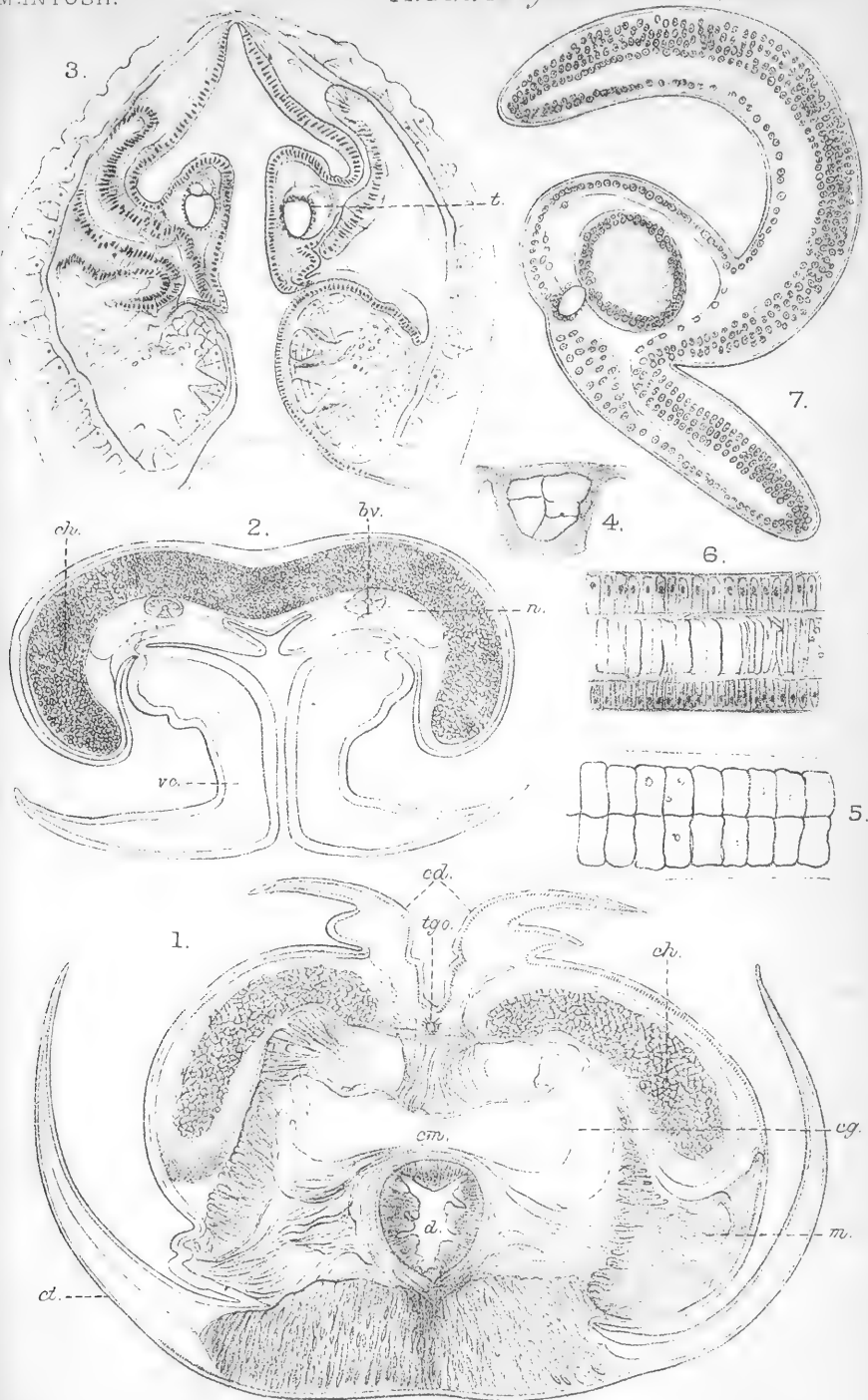
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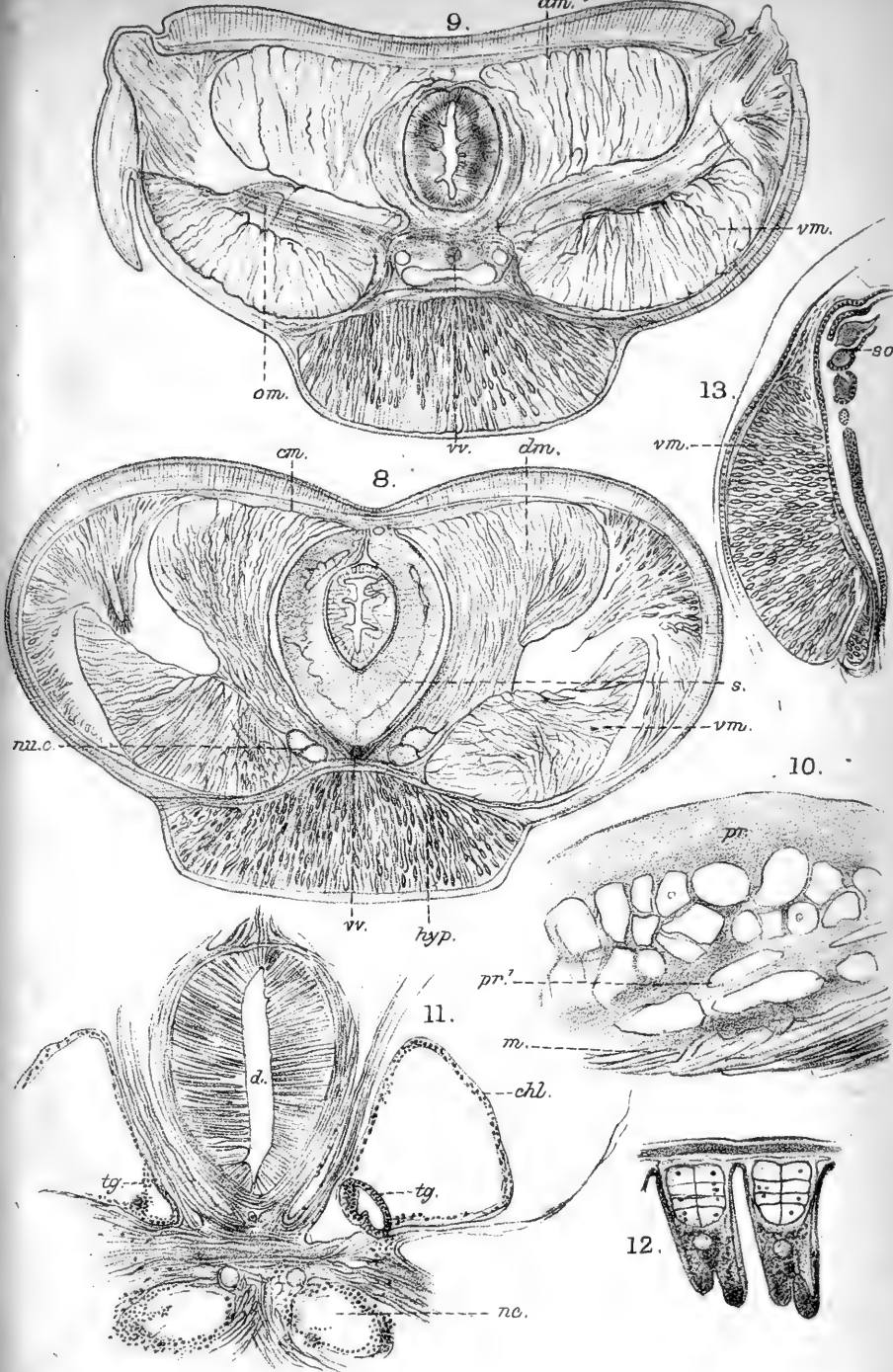
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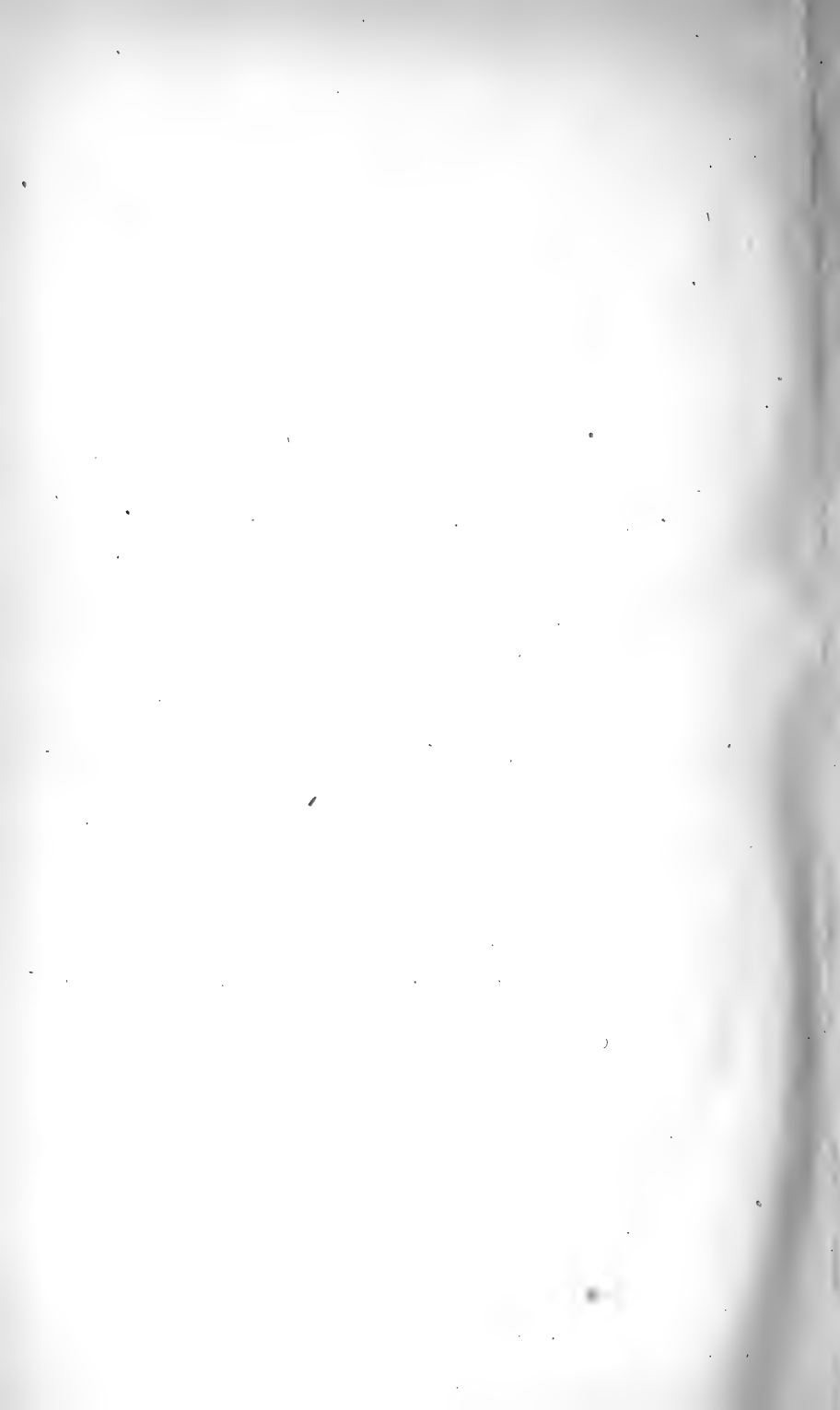
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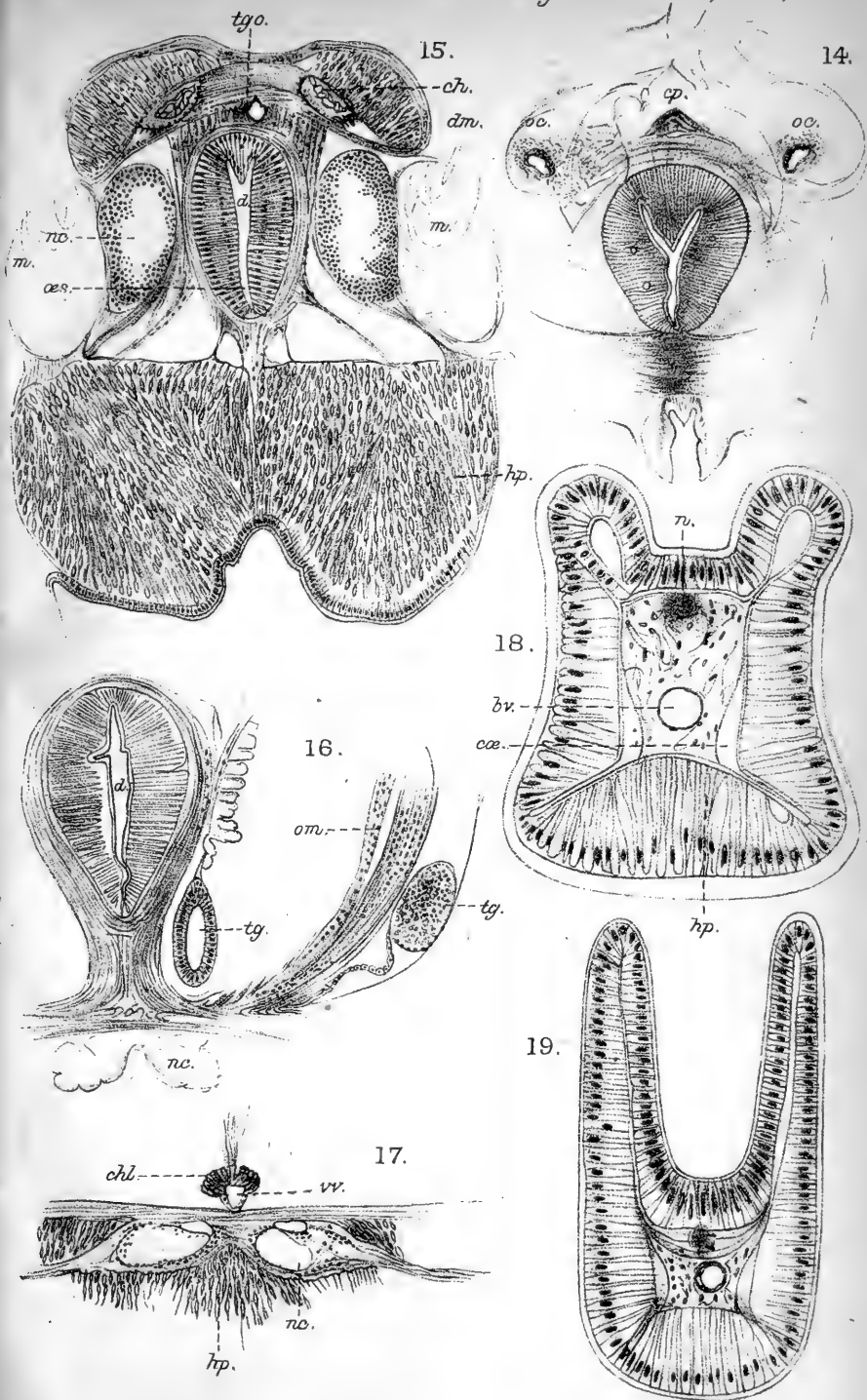
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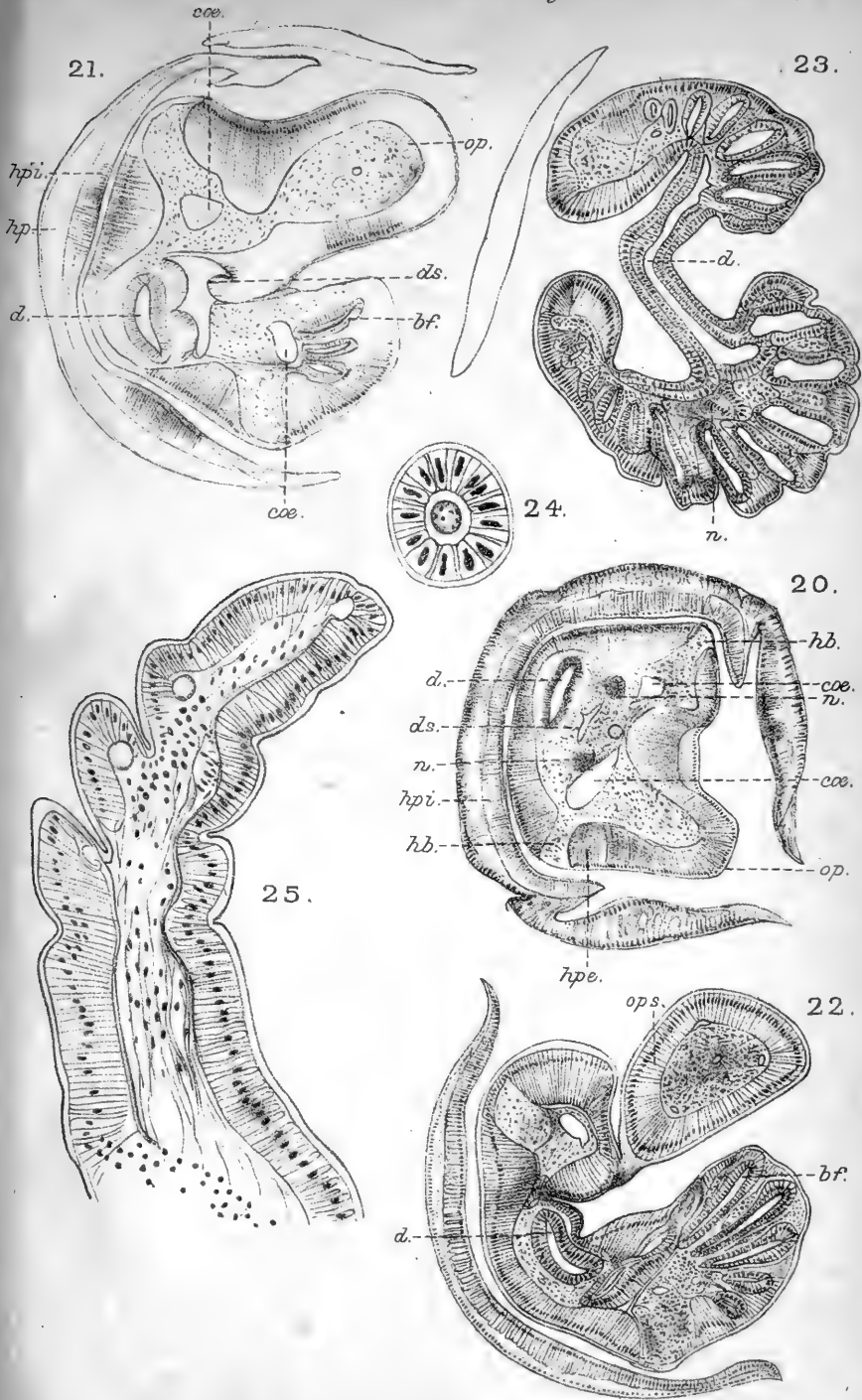


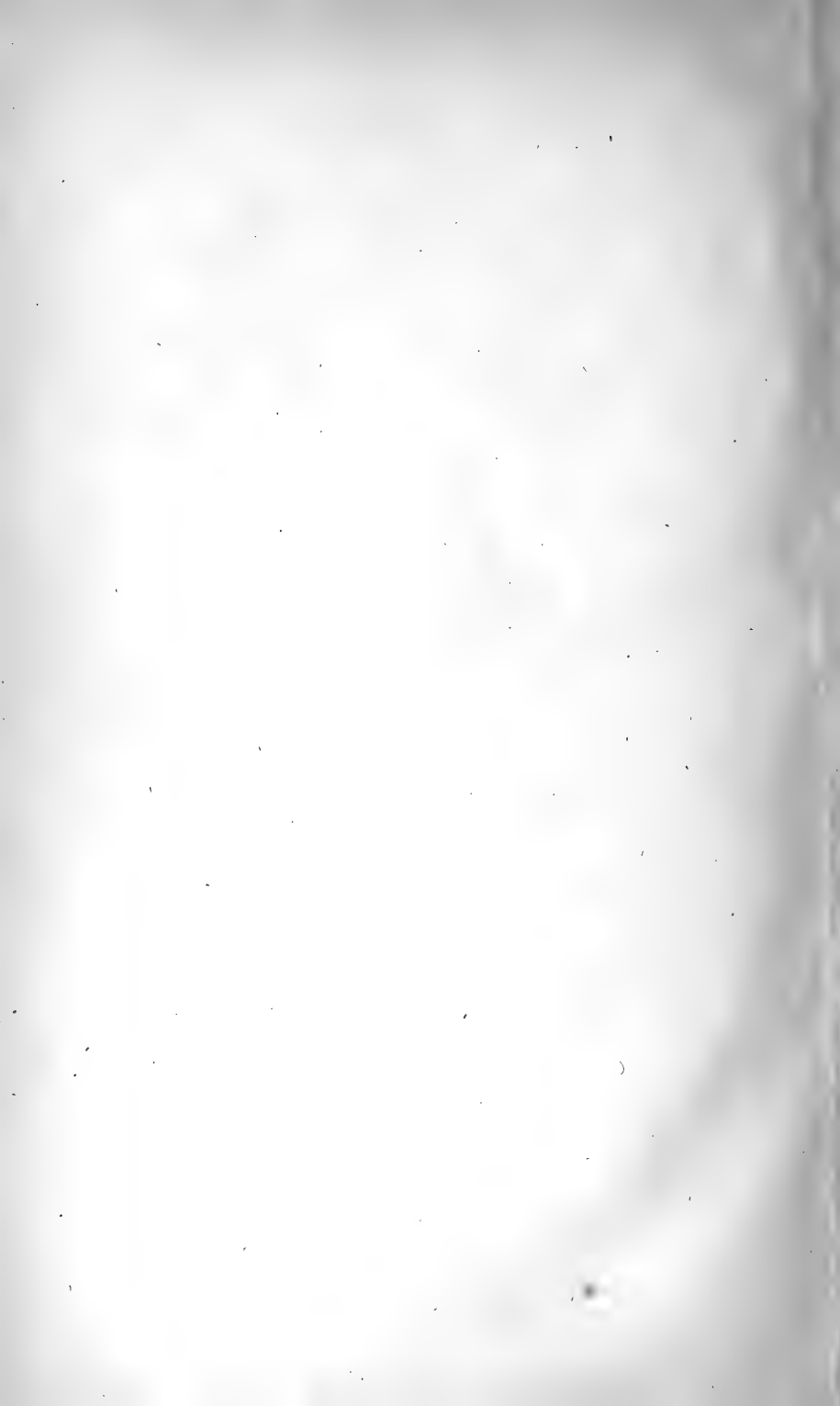


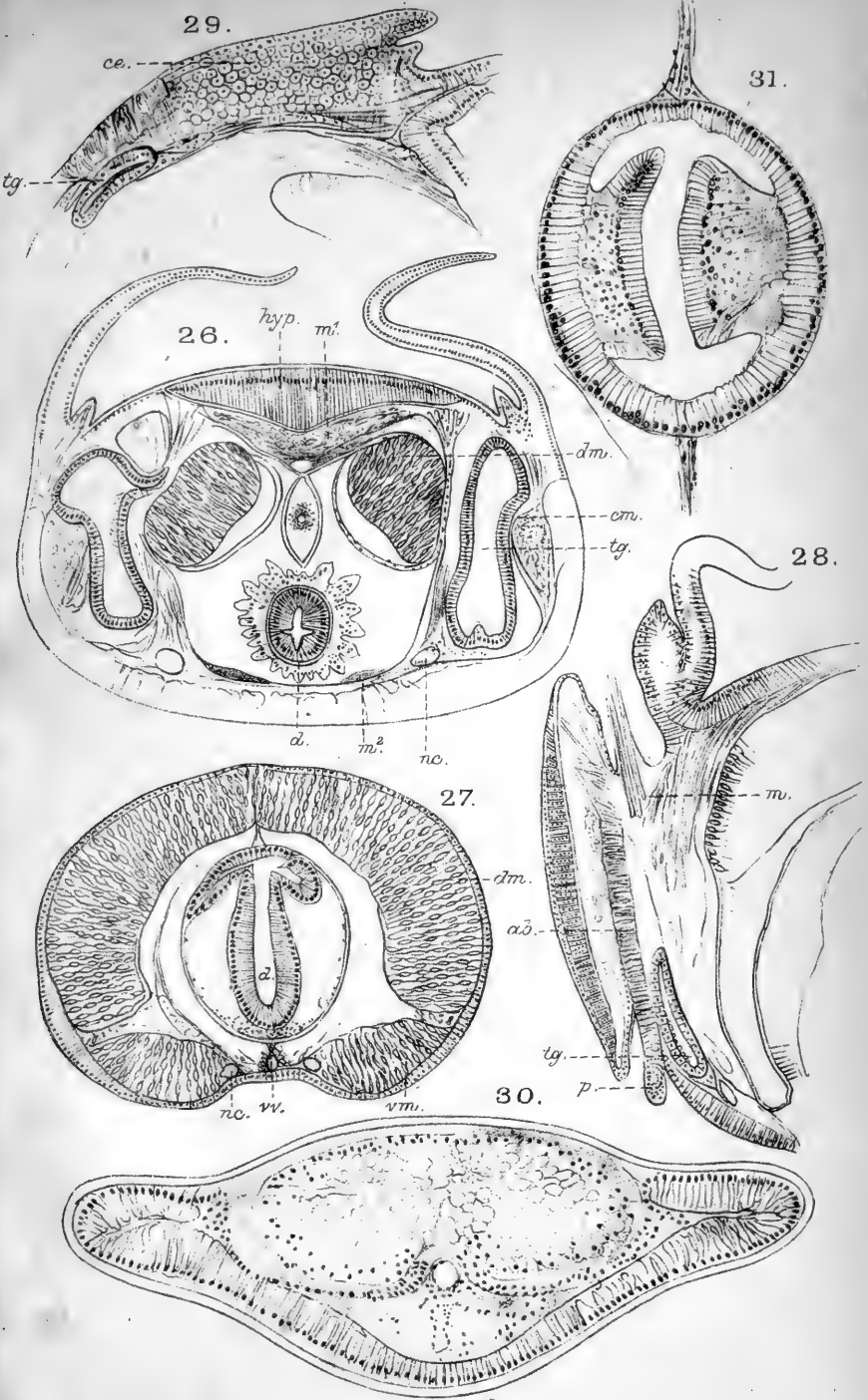


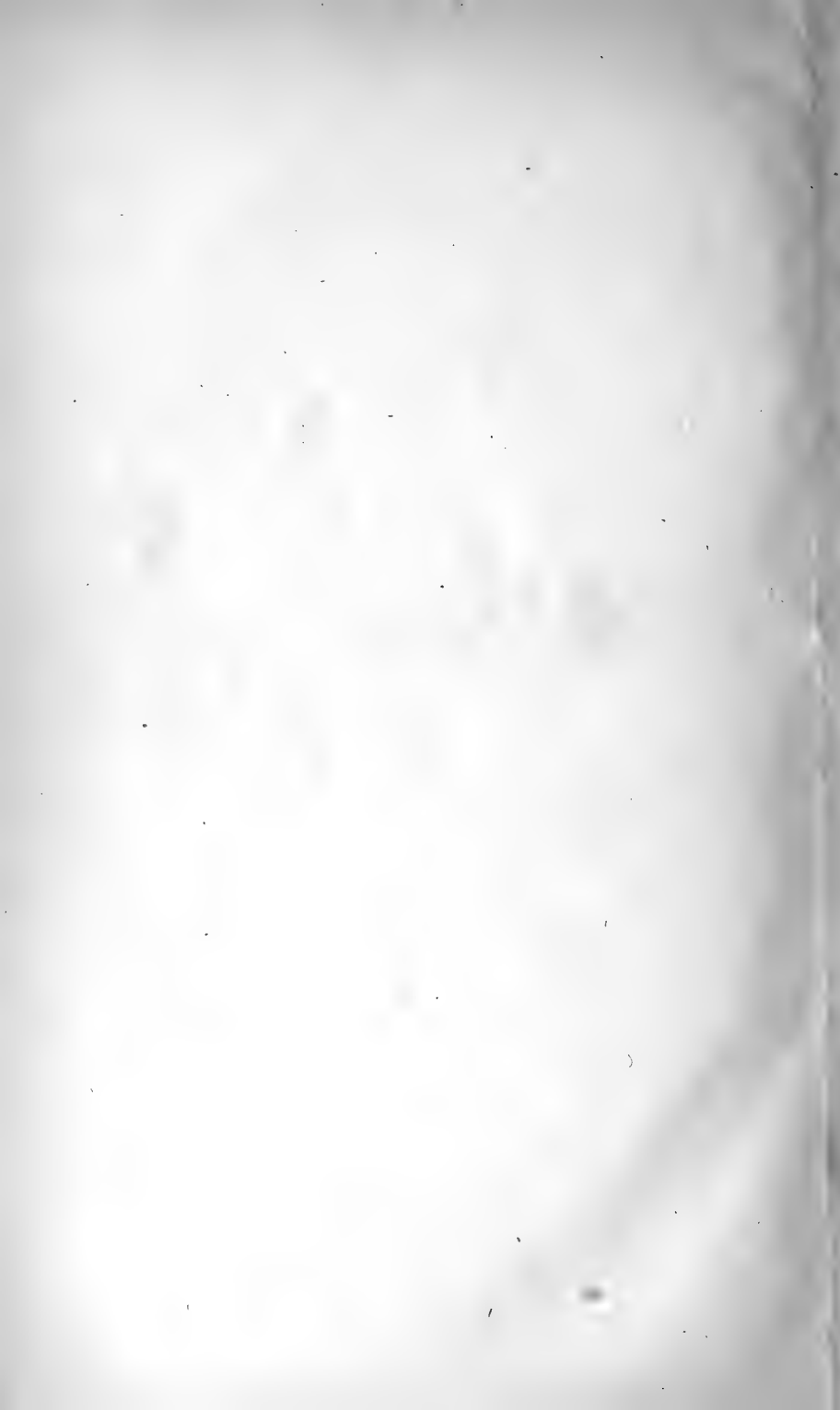




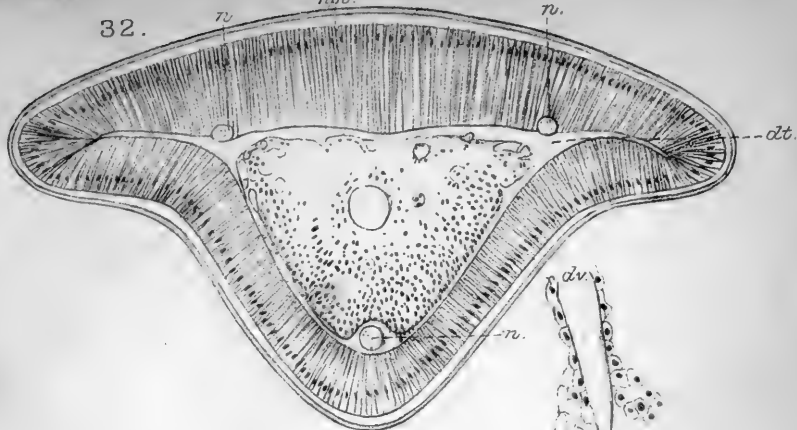




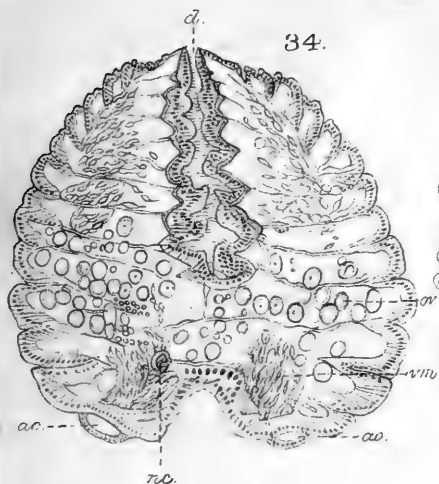




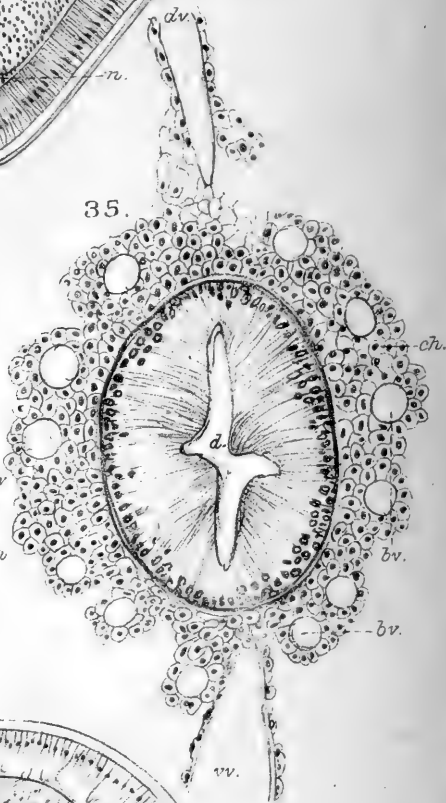
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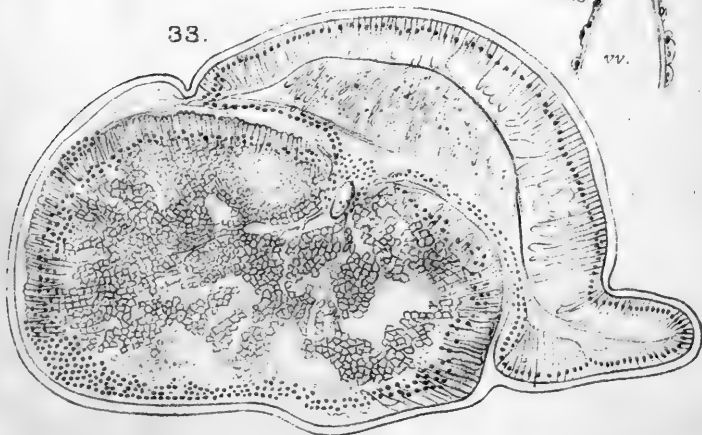
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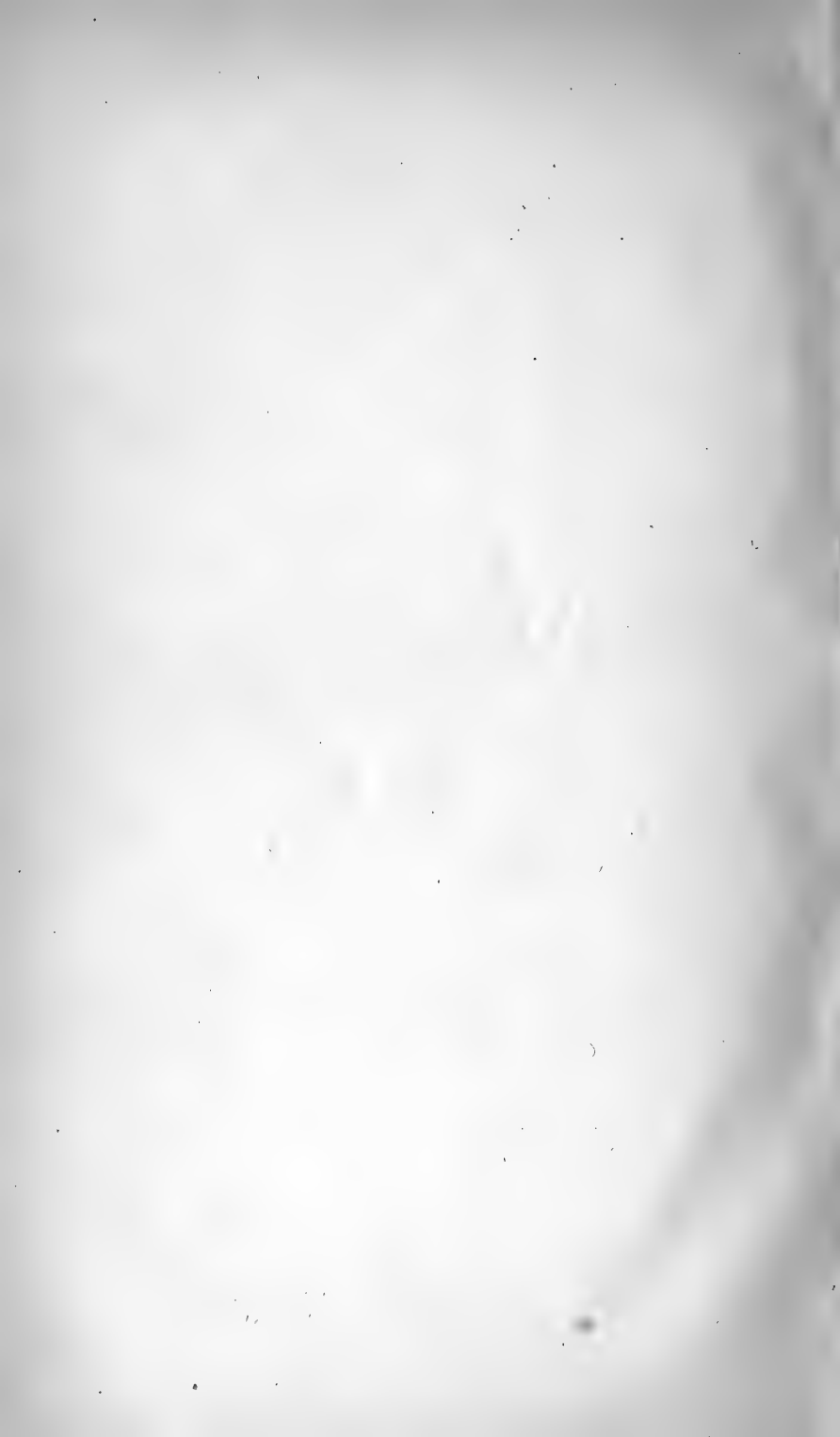


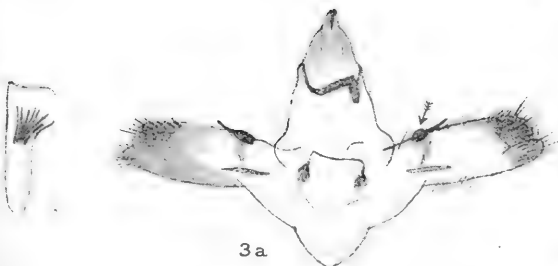
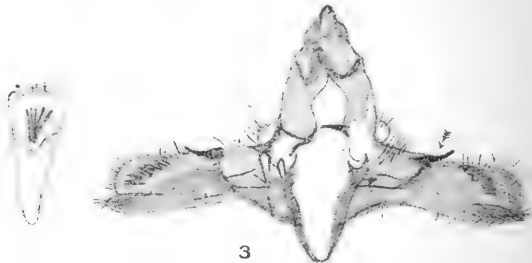
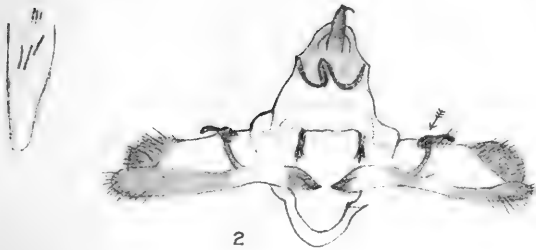
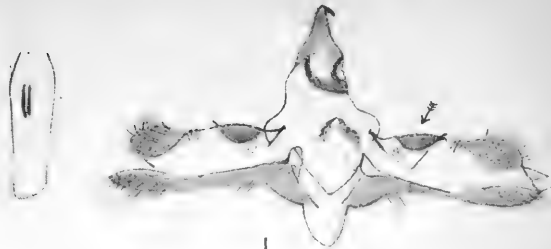
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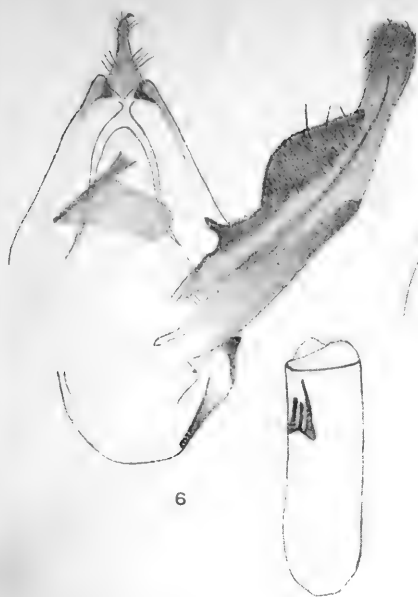
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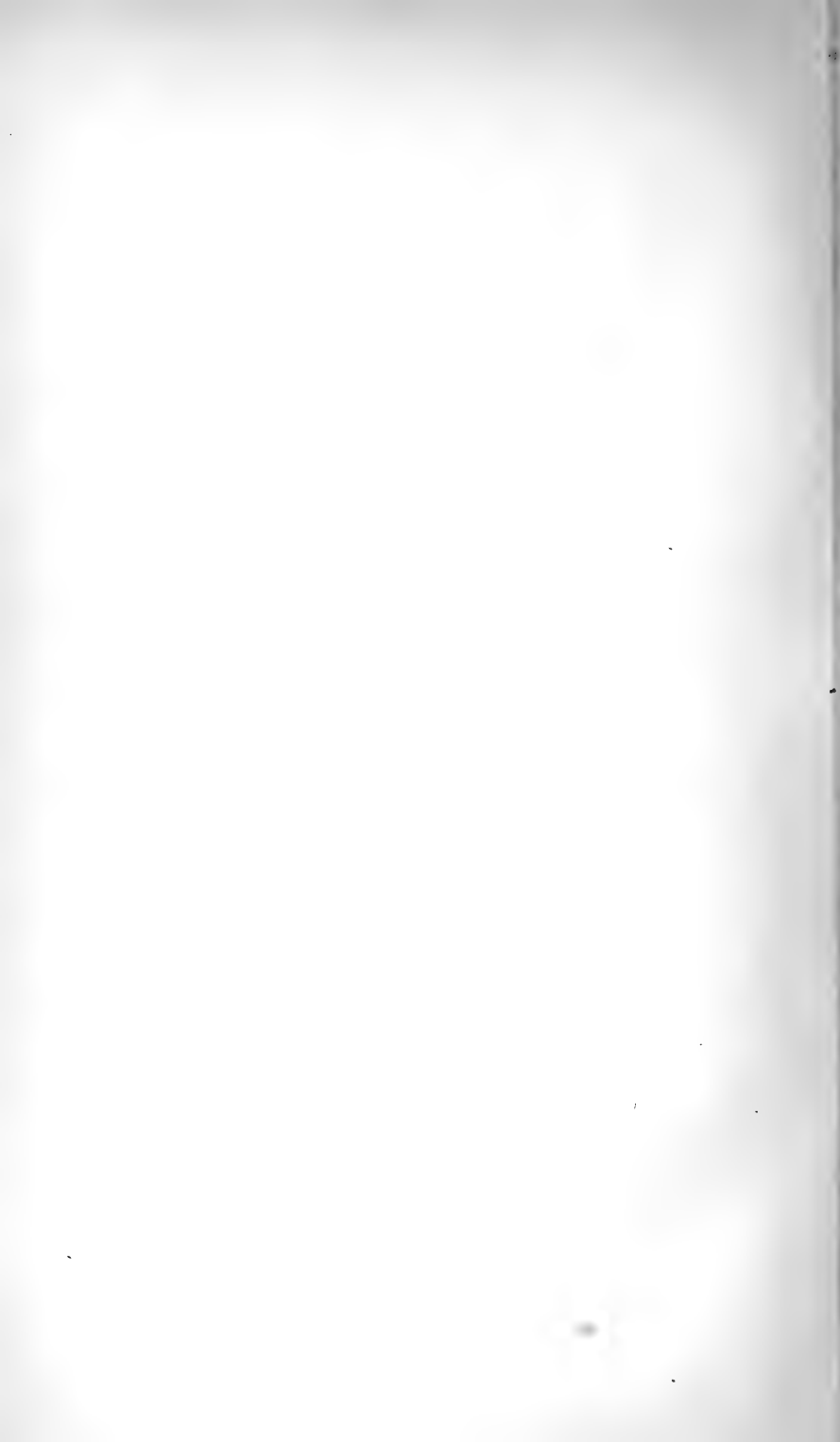


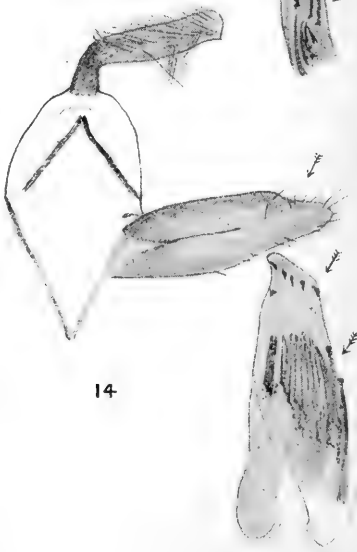
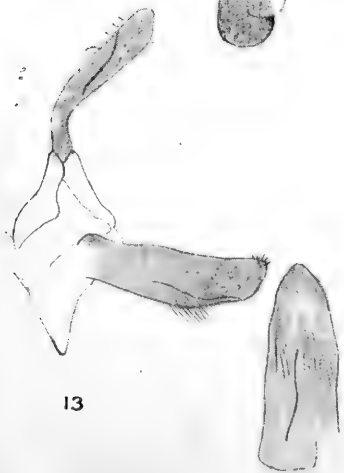
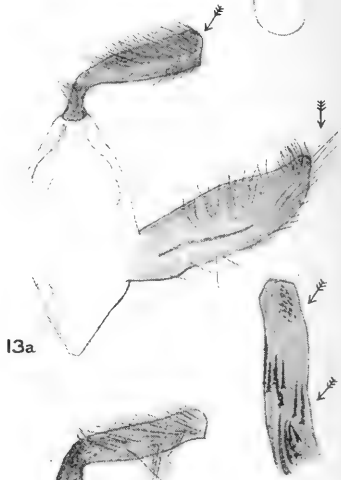
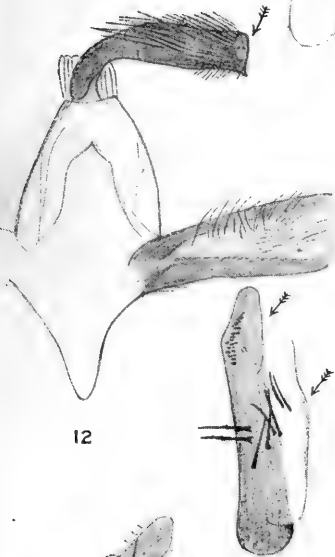
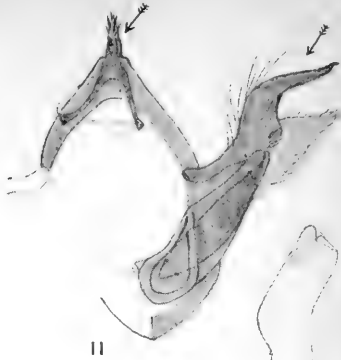


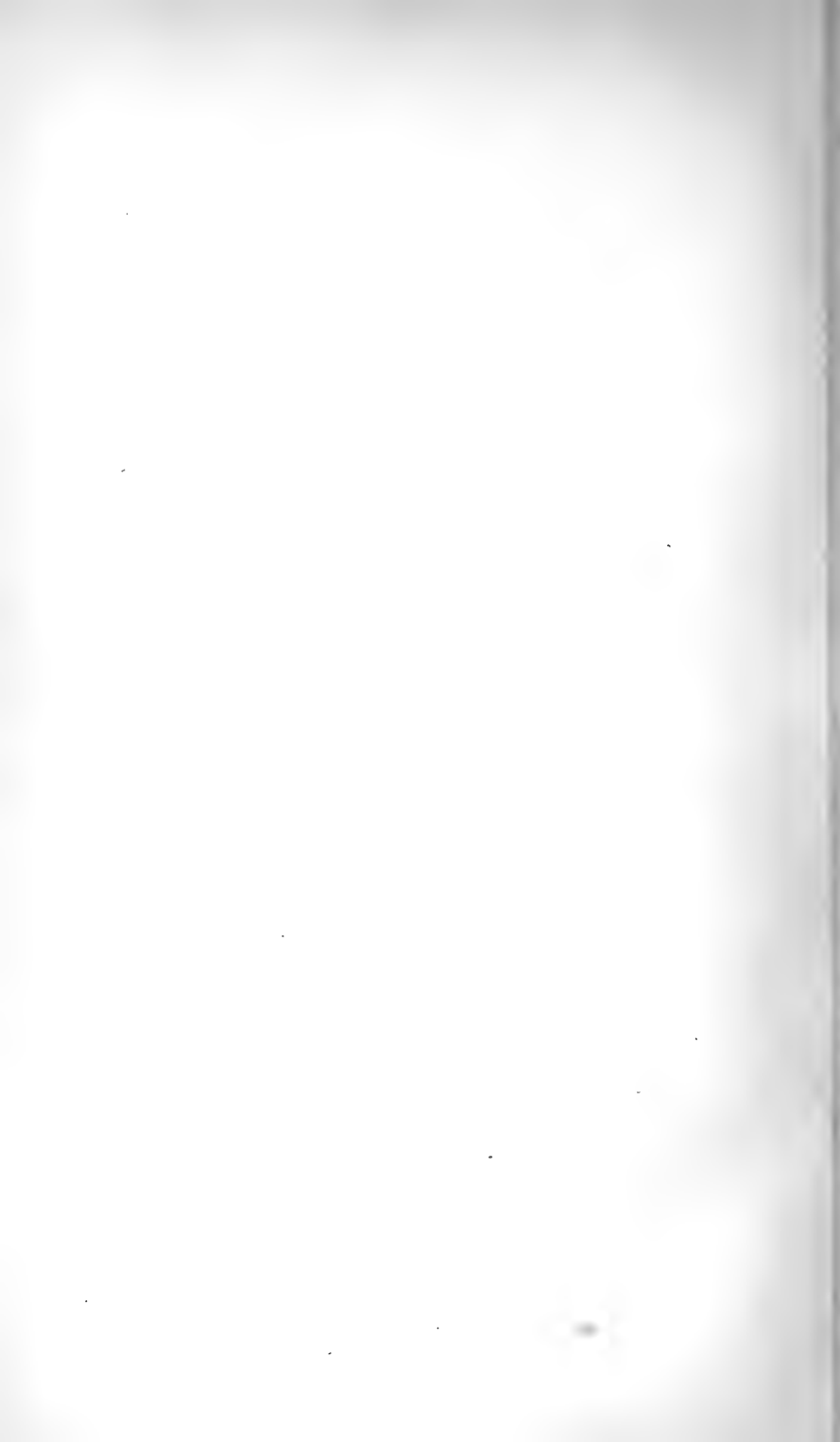


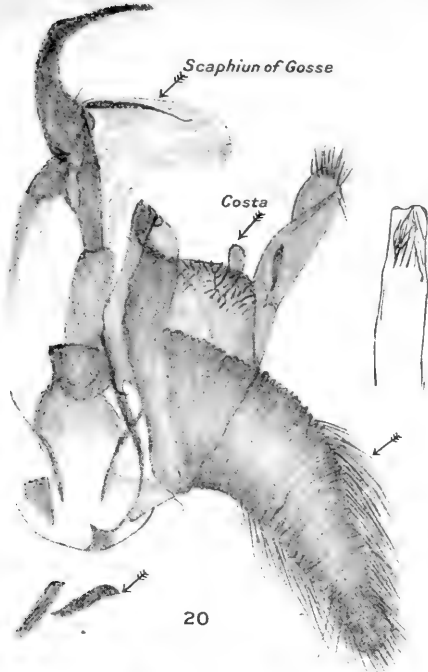








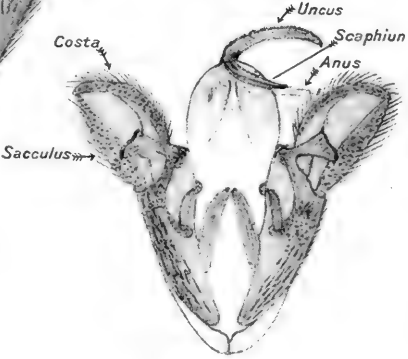




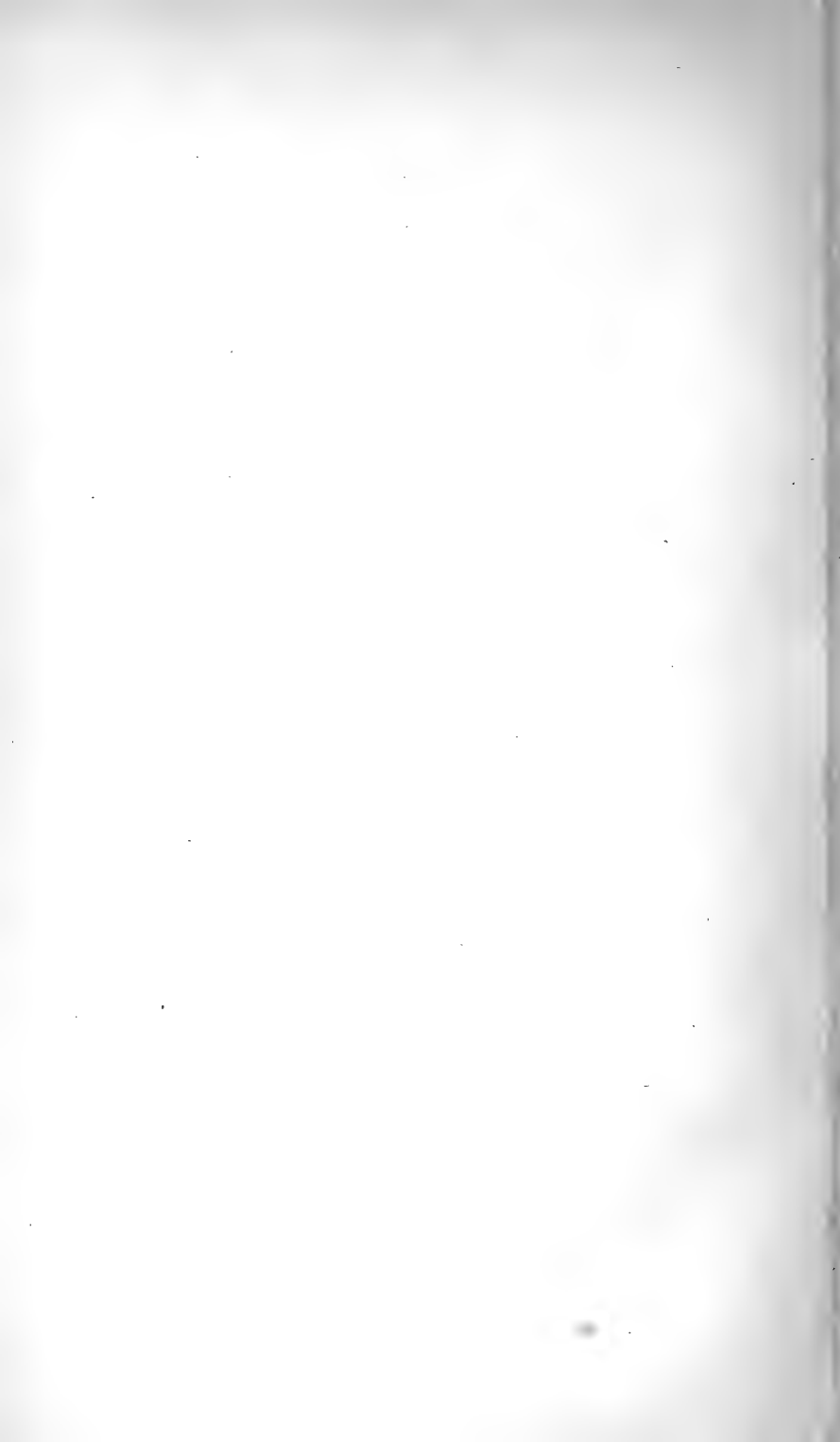
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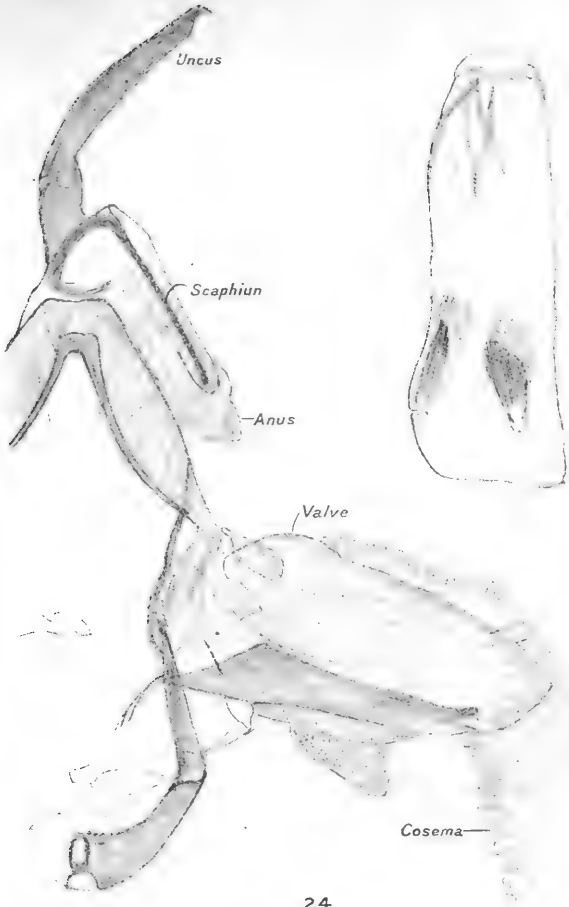


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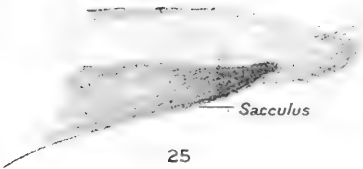


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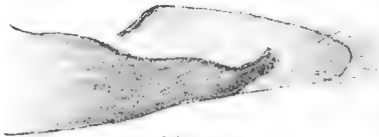




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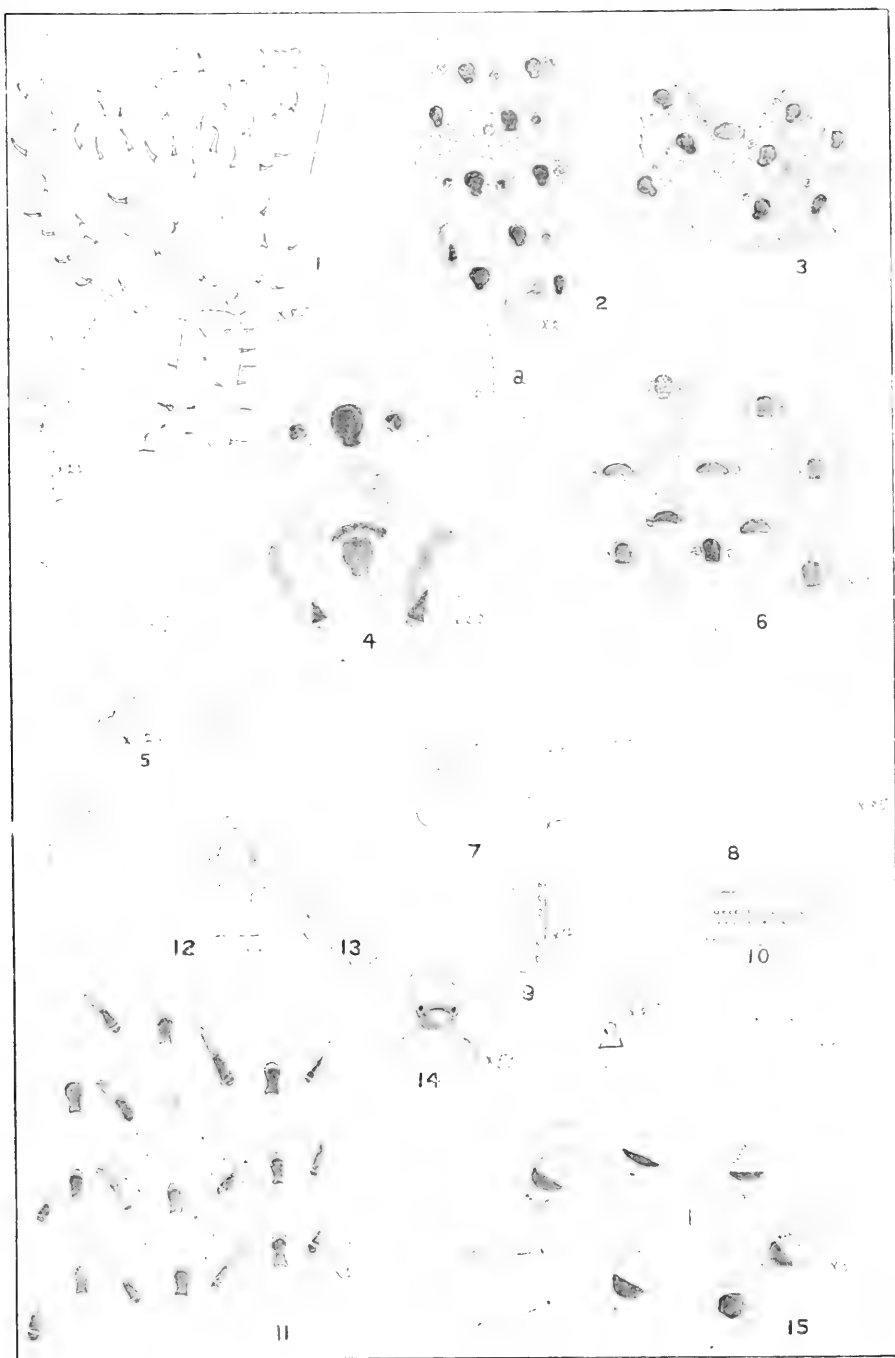


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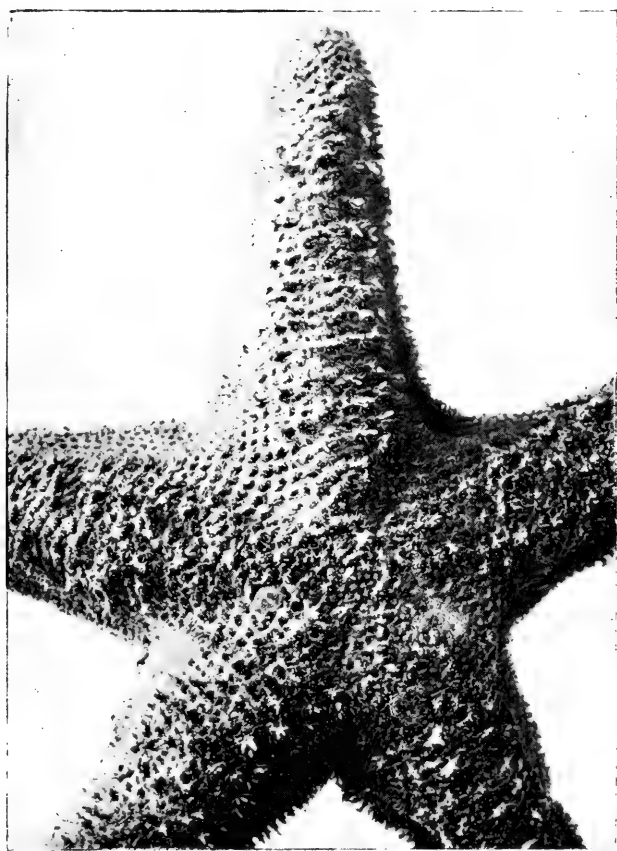


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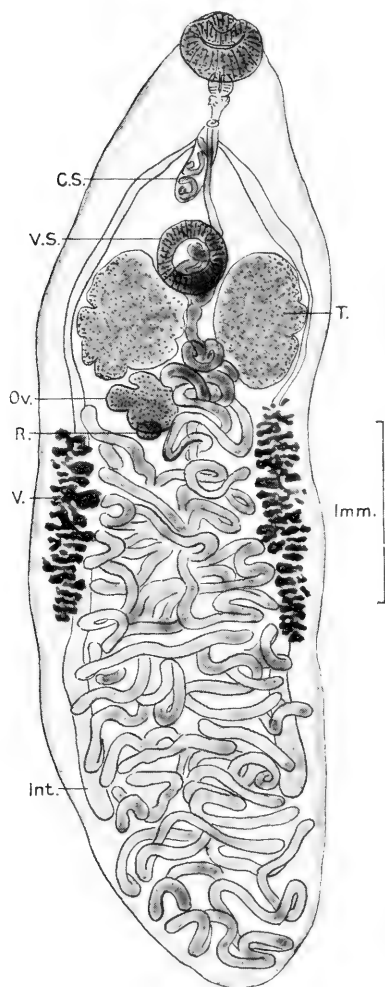






Type of *Asterina coronata cristata* (Fisher).





Dicrocoelium lanceatum, var. *symmetricum*.



FIG. 1.

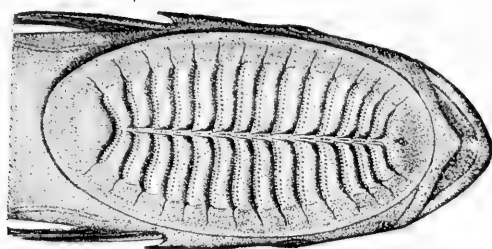


FIG. 2.

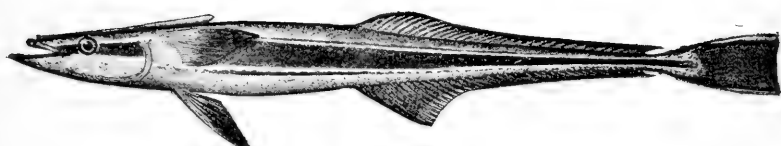


FIG. 3.

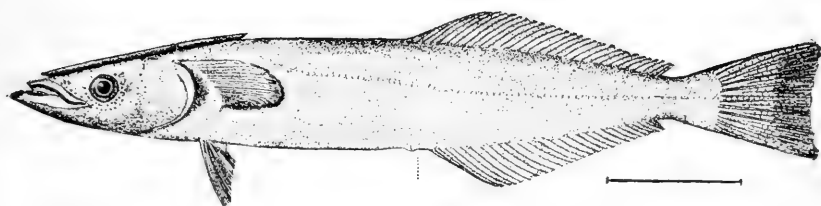


FIG. 4.

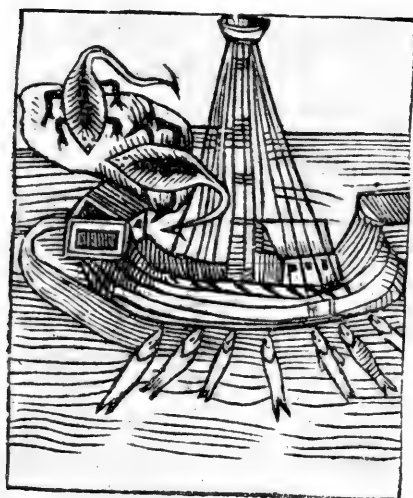




FIG. 5.

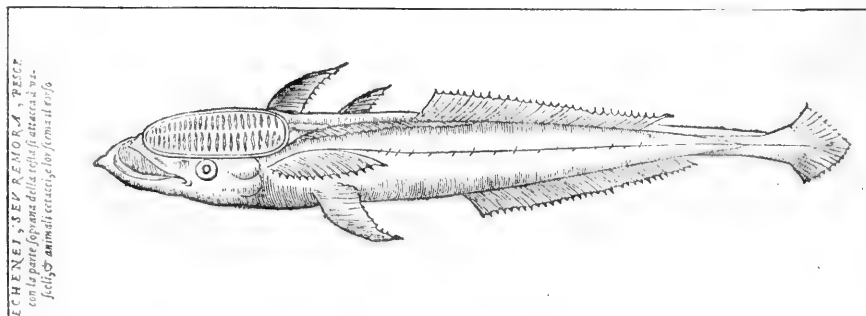


FIG. 6.

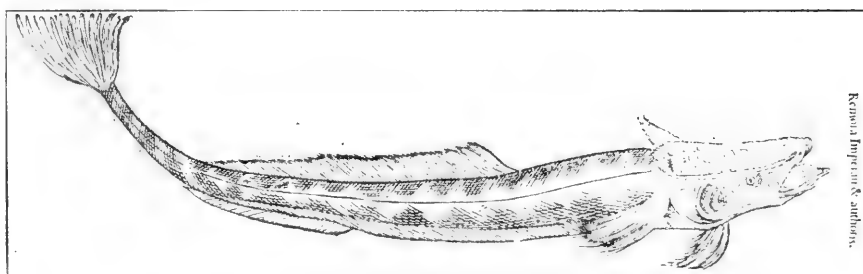


FIG. 7.





FIG. 8.

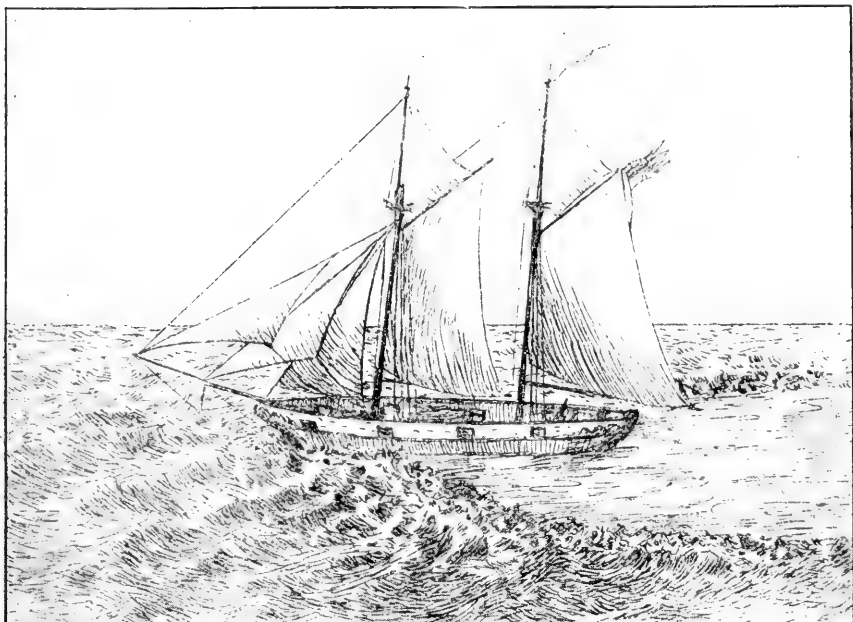
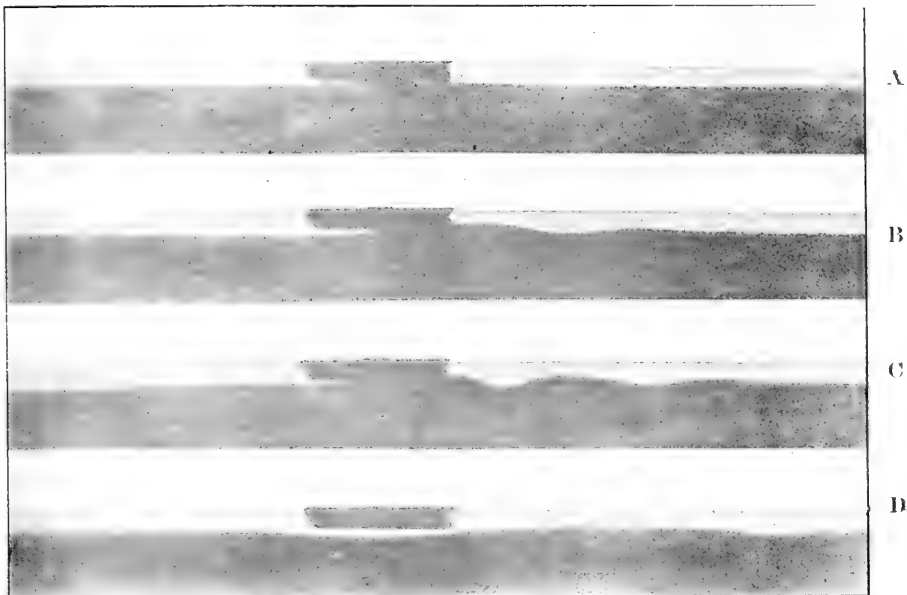
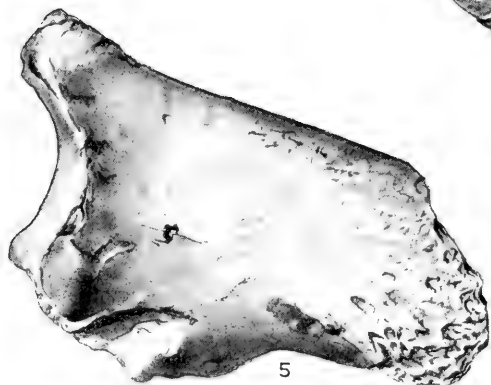
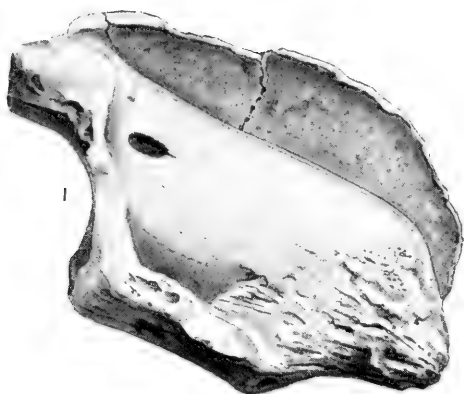
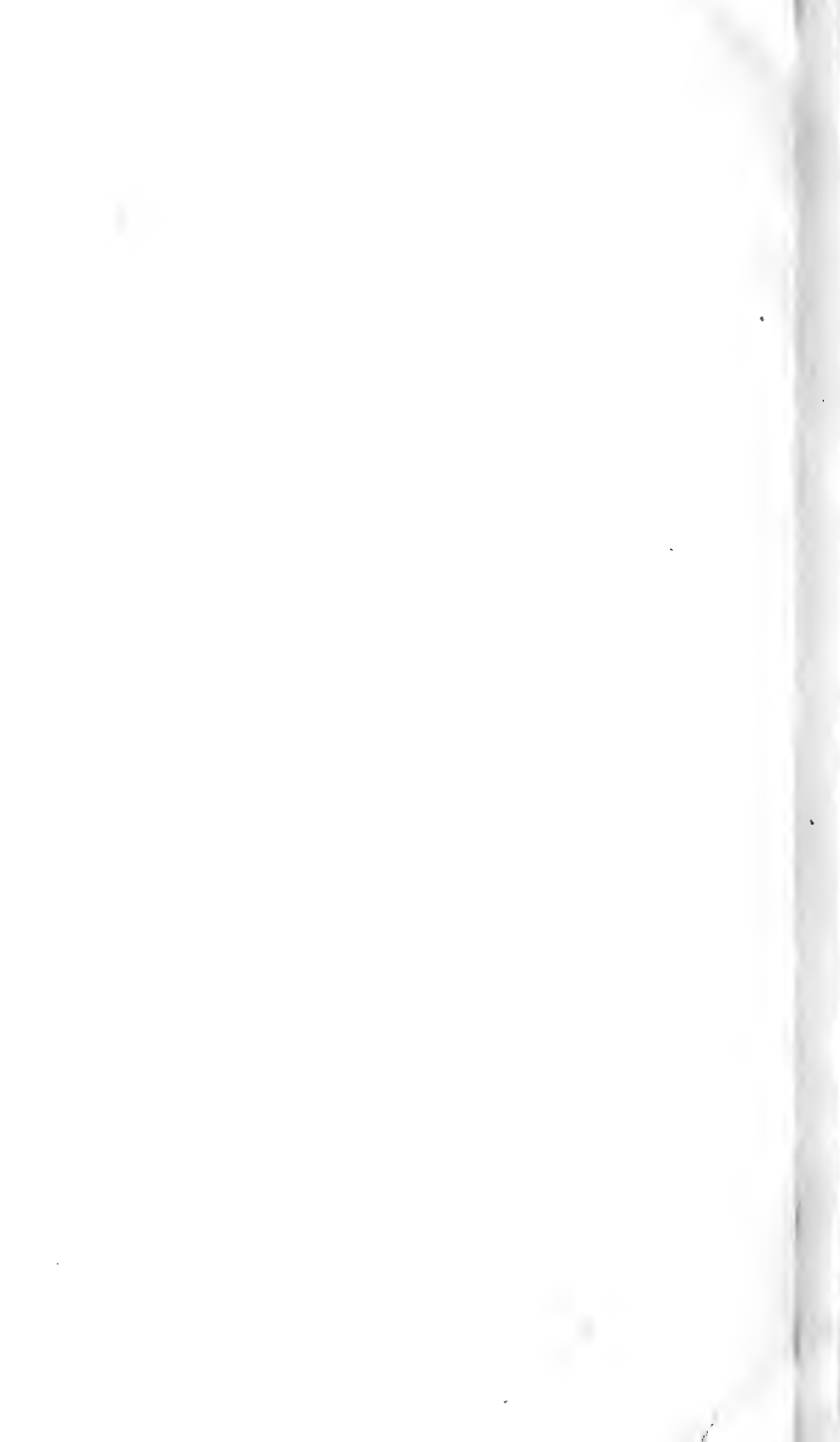


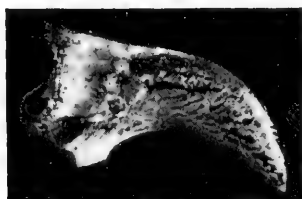
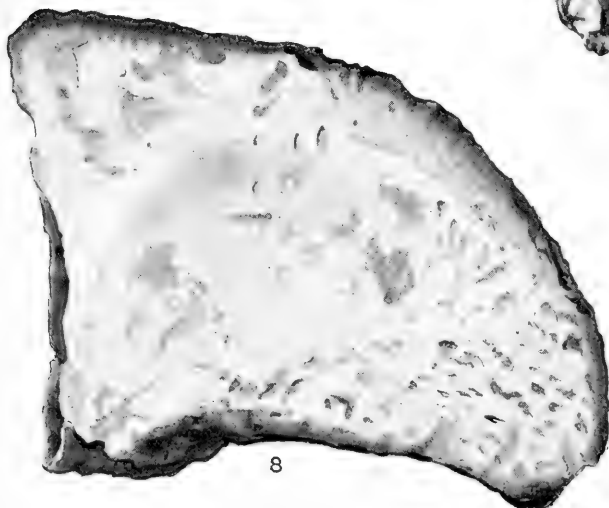
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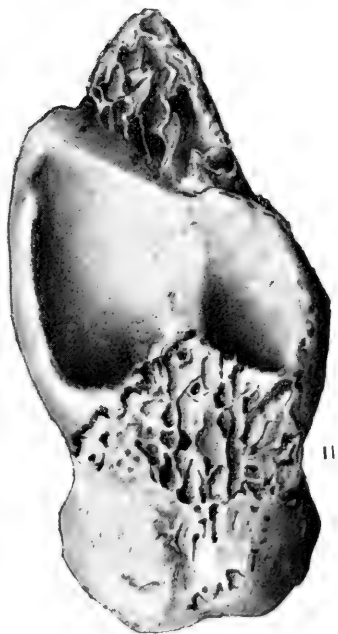
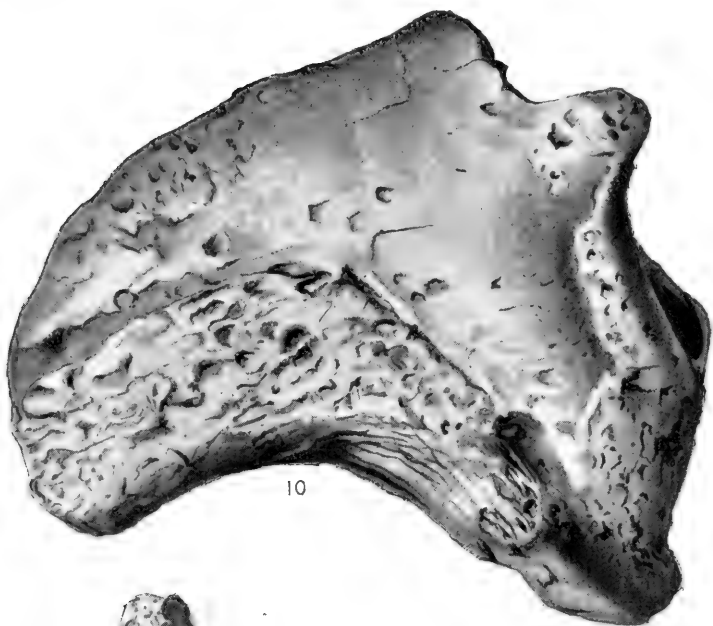




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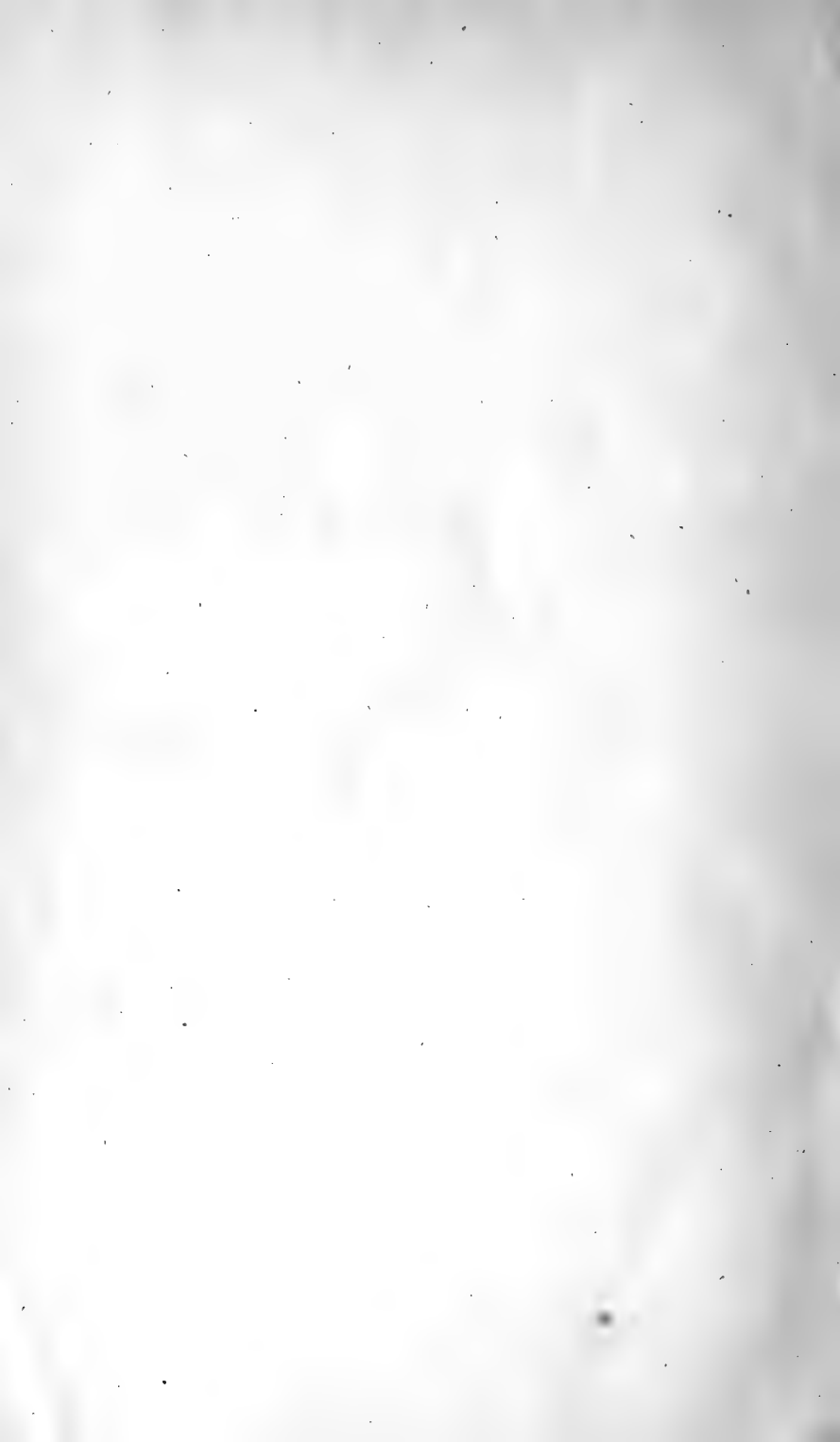
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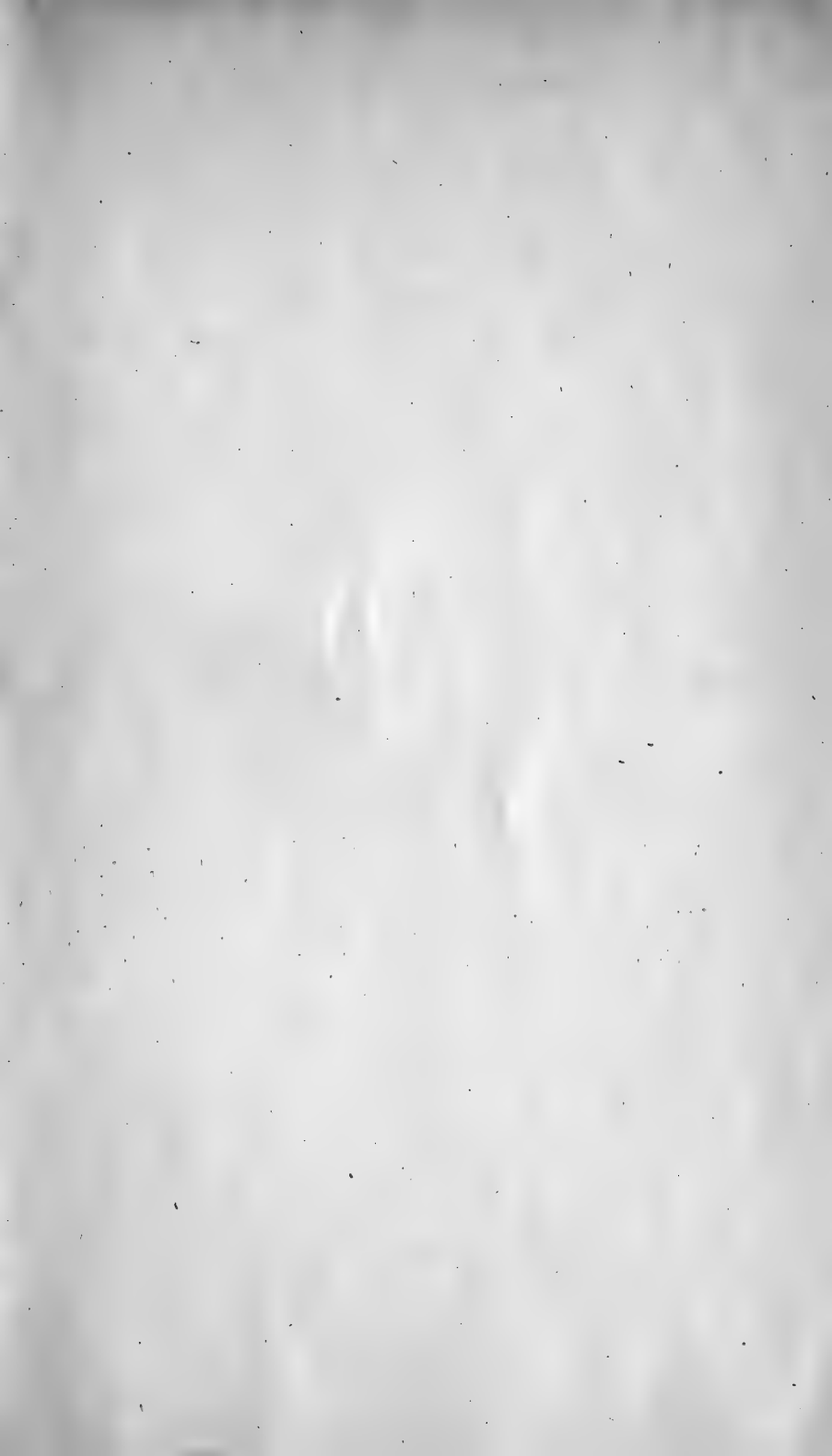
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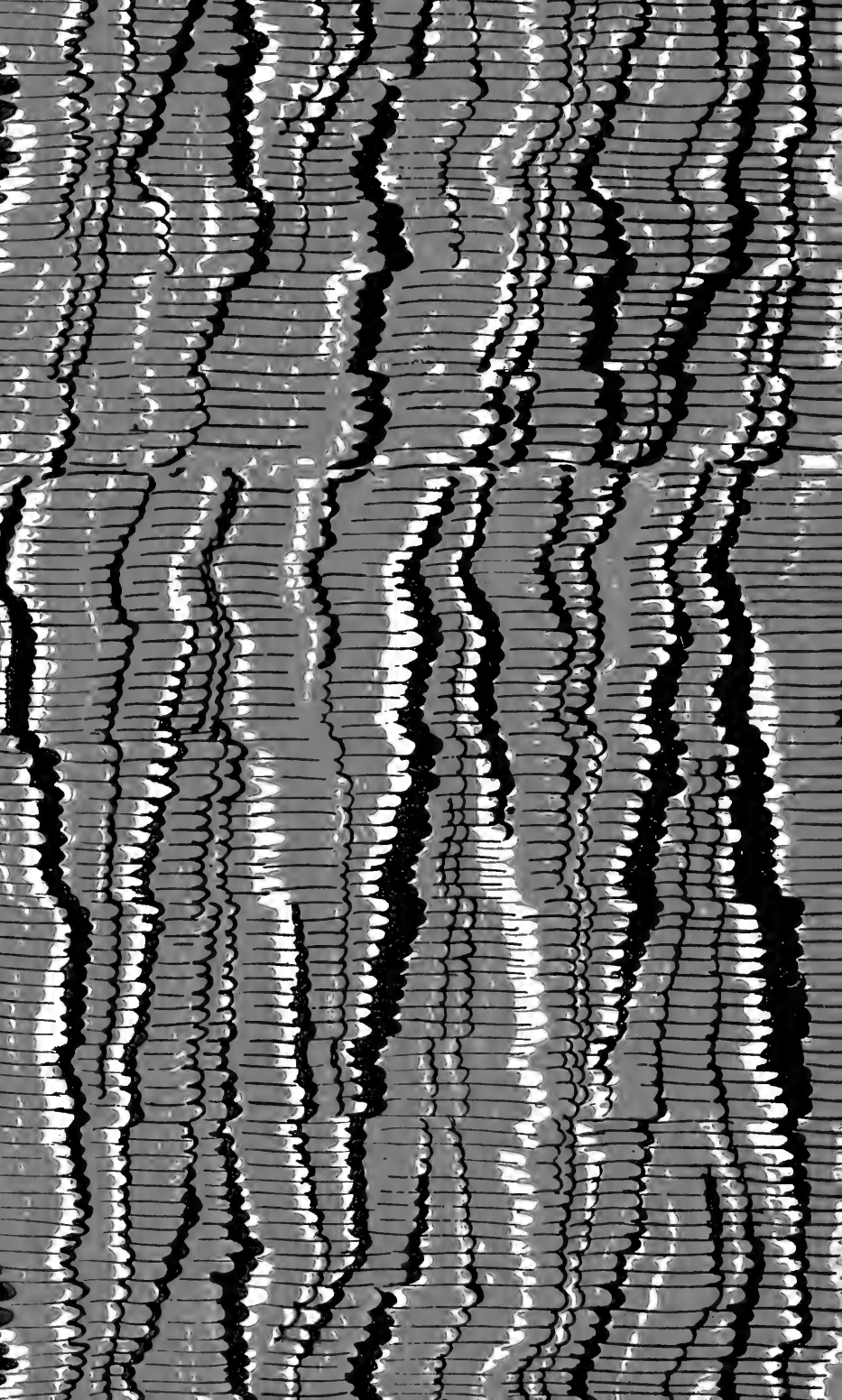
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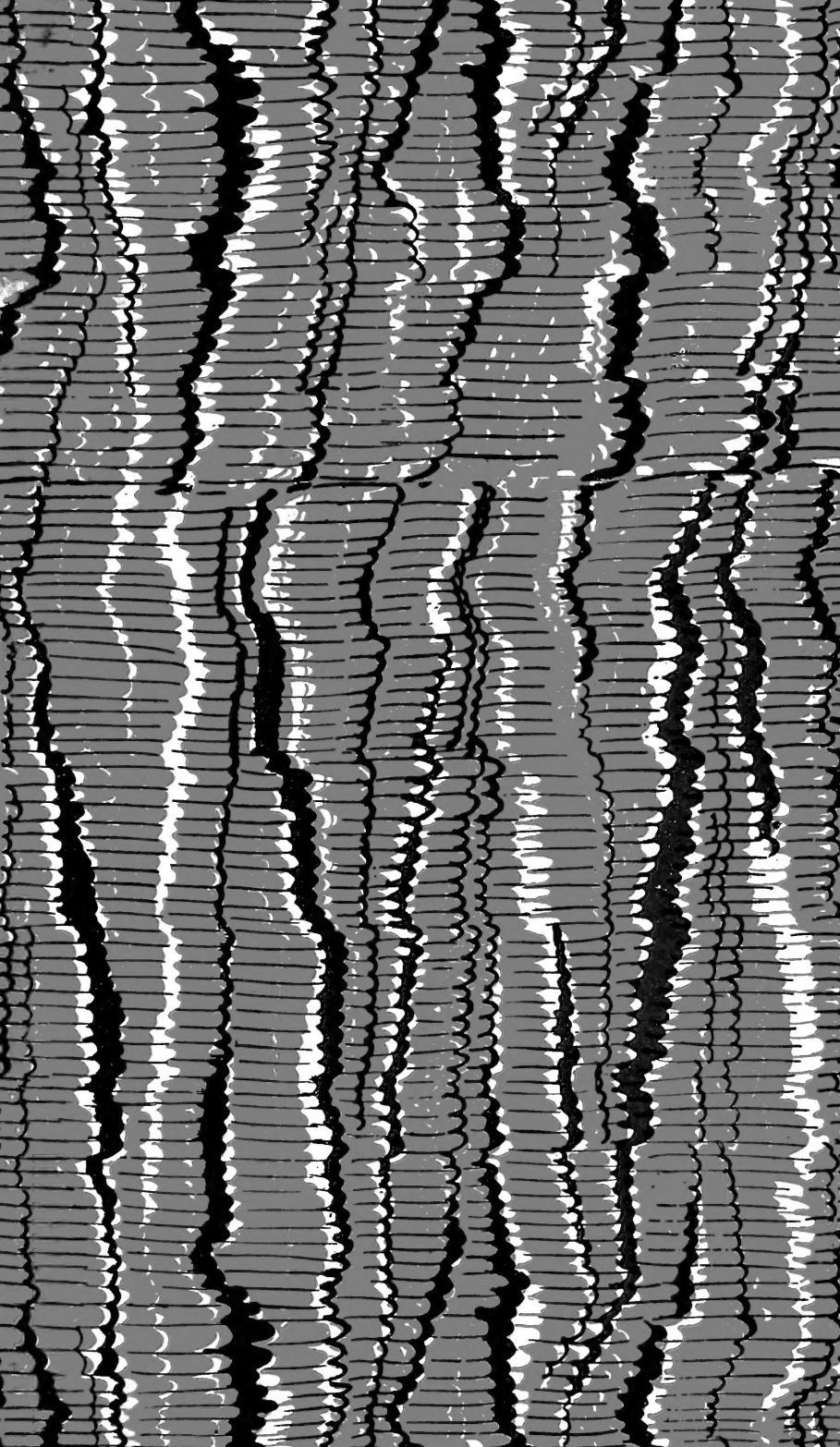














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